

UDJUNG KULON
THE LAND OF
THE LAST JAVAN RHINOCEROS

*With local and general data on the most important faunal species
and their preservation in Indonesia*

BY

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With 155 illustrations and 3 folding maps



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longest. Perhaps, too, Ujung Kulon will one day serve as the last refuge for other large reptiles, such as the monitor lizard, the python and the giant green turtle, provided the administration of the reserve is given the attention that it deserves.

PART II

THE JAVAN RHINOCEROS

(*Rhinoceros sondaicus sondaicus* Desmarest)

Plates 18-25: facing p. 112

Plates 26-33: facing p. 136

Plates 34-43: facing p. 160

CHAPTER 7

OLDER INFORMATION ON THE OCCURRENCE OF THE JAVAN RHINO IN SUMATRA AND JAVA. CAUSES OF ITS SHRINKING RANGE. THE PRESENT STATUS

As already demonstrated in great detail by Sody (1941, 1959) and also by Hooijer (1945, 1946, 1948), the occurrence in Sumatra of *Rhinoceros sondaicus* could be accepted as a certainty long before representatives of the species were shot in South Sumatra in 1925 and L. F. de Beaufort definitely mentioned them for that island once again in 1928. Probably the young animal originating from Sumatra described in 1822 by A. G. Desmarest was the first specimen of the Javan species to become known to science, although the locality of origin was later changed by the same author into Java, without the reason for this being given. The year before, the usually highly reliable S. Raffles plausibly argued that this species occurred in Sumatra, just as W. Marsden suggested ten years previously—though less convincingly—and in 1876 Gray described the subspecies *floweri* for this island.

Later discoveries demonstrated that the Javan rhinoceros must have been distributed over large stretches of Sumatra, perhaps from Atjeh in the north to the Lampong Districts in the south. For instance, Hooijer states that two skulls in the possession of the Leyden Museum came from Deli, and he also proved the prehistoric occurrence at Bindjei-Tamiang. Volz (1912) gives an illustration of the head of a female specimen which he had shot in North Atjeh. In addition Franck (1935) gives some fairly reliable reports on the more recent occurrence of the Javan rhinoceros in Atjeh in 1900, 1905 and 1925. Sody mentions an animal shot in 1927 in Langkat (North-East Sumatra). De Beaufort (1928) refers to a rhino shot in Palembang and J. C. Hazewinkel (1933) likewise obtained a number of specimens in Palembang, whilst the well-known Bandung big-game hunter J. T. Hamaker showed the present author two mounted heads which had been secured in the Lampongs.

With reference to Hazewinkel's rhino shooting in South Sumatra (see also p. 59), Guggisberg (1966) writes: "...for when J. C. Hazewinkel, a Dutch big-game hunter, published photographs of some one-horned rhinoceroses he had shot in Sumatra, he caused a regular uproar. At first there was talk of a completely new species having been discovered, and when somebody finally recognized the identity of the animals, they were supposed to have been found in a place where *Rhinoceros sondaicus* had no right to exist!" However, as is evident from the above the occurrence in Sumatra of this rhino species was known long before Hazewinkel killed his animals; it was perhaps not fully realized that they were shot illegally and that they probably were the very last Sumatran specimens still surviving within that particular part of the world, because nobody saw or tracked one thereafter. A recent report (Reynolds 1960) that two rhino belonging to this

species were caught in this island in 1959 is most probably not correct; in that year at least four *Dicerorhinus sumatrensis* were captured there, of which two reached Europe (Skaftø 1961).

After examining 46 skulls of *Rhinoceros sondaicus*—perhaps all of them kept in scientific collections—Groves (1967), on account of skull and tooth measurements, recognizes three different subspecies, viz. *Rhinoceros sondaicus sondaicus* Desmarest for Java, *Rhinoceros sondaicus floweri* Gray for Sumatra, and *Rhinoceros sondaicus inermis* Lesson for the Sunderbunds, the swampy jungle-clad islands of the Ganges Delta.

Although Groves (1967) accepts that Desmarest's type specimen comes from Java and not from Sumatra, he apparently did not examine the skull of that animal.

Hooijer has been able to demonstrate that the Javan species, together with the two-horned Sumatran rhinoceros (*Dicerorhinus s. sumatrensis* G. Fischer), was also living in Sumatra in prehistoric days, since teeth and fragments thereof, collected in the Padang Uplands, among other places, by E. Dubois around 1890 belonged to these two different species. On the strength of the material examined it is assumed that the Javan rhinoceros, even in prehistoric times, occurred less generally on that island than the Sumatran species. Hooijer further concludes that *Rhinoceros sondaicus* can be crossed off the list of Bornean mammals on the basis of material available so far.

With regard to its occurrence in Java considerably more data are available, concerning both the population density two to three centuries ago and its range.

F. de Haan (1911-1912) mentions a trip made by Albrecht Herpoort in 1662 in the vicinity of Bekasi (West Java). Whilst sailing along the river of that name he saw many rhino coming to drink there or foraging along the banks. In that same period the Town Clerk of Batavia (Djakarta), Dirk Jemming, whilst driving in the vicinity of that town, encountered a rhino, which he "fought". Jacobus Bontius, who lived in Java from 1627 up to his death in 1631, came across a young rhino whilst out walking near Batavia, and he spoke of the meeting as though this species was definitely not a rarity in the vicinity of the town. Incidentally, on another occasion he claimed to have seen more than a hundred such animals in captivity and also often to have encountered them in the forests. The *Dagb-Register gebouden in 't Casteel Batavia* (official Government diary) states that on 29 September, 1661, a live, female rhino was brought in which had been caught near Krawang in the mud by the river (Anonymous 1887-1931). "Old Batavia", the Memorial Book of the Bataviaasch Genootschap van Kunsten en Wetenschappen (1919), also tells how at the beginning of the seventeenth century rhino and banteng were encountered in the immediate vicinity of Batavia, indeed were by no means a rarity. This situation seemed to continue for a long time, for about a century later, according to the same Memorial Book, a premium for killing a rhino had to be paid more than thirty times a month.

From what François Valentijn tells of the beginning of the eighteenth century, such an abundance of rhino near Batavia is not, however, apparent; he states that



Native sailing proas were most frequently used when visiting the reserve



... and almost without exception tents were the normal means of staying the night



Sunset photographed from Tjikuja Bay; left Java's First Point, right Pulau Peutjang



Niur Bay, one of the most beautiful localities of the reserve

now and again a specimen would stray near the town. But he recounts the remarkable story of a tame young rhino which, during a siege of the town, was driven out of the walls by his keepers before the gates were closed but walked back in again when peace was signed and the gates re-opened.

However, about the middle of the eighteenth century the number of rhino in Java was nevertheless so large that the damage done and inconvenience caused by these pachyderms obliged the Government to promise a premium of 10 crowns for the killing of a rhino, as emerges from the *Nederlandsch Indisch Plakaatboek* of 1 September, 1747 (Anonymous 1602-1811; Van der Chijs 1885). This also contains a note to the effect that between mid October 1746 and the end of August 1747 60 rhino were killed, for which premiums of 860 crowns were paid! On 14 January, 1749, it was noted in this Book that the bounty had been withdrawn because the costs were too high, for since 1 September, 1747, premiums had been paid for the killing of no less than 526 rhino and 80 tigers! Sody (1959: 131) also quotes this, but doubts the accuracy of these figures. However, he adds that the fact that the authorities dared to mention such a high number (the total sum paid out is also given, so that a mistake may be considered out of the question) is a fairly reliable indication that in those years rhino must have been quite numerous.

There are accounts aplenty of the occurrence of rhino within very widespread parts of West and Central Java during the whole of the nineteenth century, but they relate in particular to the higher regions and the unpopulated or extremely sparsely populated plains of South Java. Reliable reports of the presence of the species on almost all the large volcanoes west of Mt. Slamet have been recorded. Although Mt. Salak is not mentioned among these, it is highly improbable that this volcano would form an exception, the more so since rhino are reported as occurring in the adjoining Janlappa area. In 1827 G. van Raalte, an assistant of the naturalists S. Müller and H. Schlegel and at the same time clerk and draughtsman of the *Natuurkundige Commissie*, was attacked in the Preanger Regencies near Mt. Parang by a rhino and seriously injured. Thanks to the quick assistance of Dr. Macklot his life was saved, and he was later able to give an exact account of what had happened to him, which may presumably be regarded as highly exceptional.

According to F. A. Jentink's Catalogue (1887) the members of the *Natuurkundige Commissie* collected five rhino in Java in the nineteenth century. Although a newspaper story mentioned a rhino hunt in Pekalongan, i.e. in the northern plain of Central Java, it is not entirely certain whether the hunt was concerned with animals captured in the vicinity, since three rhino and eight banteng were being hunted inside an enclosure. However, it need by no means be considered out of the question that *Rhinoceros sondaicus* was still living there at that time (1829), since there are reliable reports from 1866 and 1867 of its occurrence on the slopes of Mt. Slamet. T. Horsfield was shown a captured young rhino in 1817 at Surakarta; this animal was said to have been trapped one or two years before in the forests of the province of Kedu. Sody (1959: 139) even mentions an account of a hunt for a rhino cow and its calf in the vicinity of Salatiga, between

Semarang and Djokjakarta, and the capture of a young specimen in 1833 near Wonosobo in the eastern part of Central Java. A not entirely reliable report (Cordes 1881) states the species' occurrence in the Ngawen district between Rembang and Semarang. The most easterly point of occurrence is given by Franz Junghuhn, viz. south of Kediri, but he adds that the Javanese living in this area were greatly surprised at the sight of this animal and regarded it as a great rarity. Fossil remains were found in the Randublatung district south of Rembang and in the Sampung Cave near Ponorogo (Dammerman 1934), so that perhaps this region did form the eastern limit of its range.

Groves (1967) is perhaps right in assuming that the absence of rhino in Eastern Java is connected with the fact that in that part of the island deciduous forest replaces the evergreen forest. He adds that there are very few reports of rhinoceroses from similar forests in a belt across the Shan States, Northern Thailand and Northern Laos.

A rather strange story comes from the coffee-planter Gelpke, who in 1834 shot a big rhino on the island of Nusa Kambangan, situated just off the south coast of Central Java. This animal had lived there for years and was so tame that it repeatedly spent the night by human settlements and ate with relish the waste thrown to it when the rice was pounded. The inhabitants of the island regarded the animal as sacred, and gave it the name of "Kerto Dupo", after a man who had been killed when collecting edible swift's nests. The animal was finally killed because of the excessive damage it did to the coffee plantations, and its head was presented to a museum in Batavia.

The report by A. Adams, already given at the beginning of this book, stating that rhino occurred along Mecuwenbaai (Muara Tjikuja), is probably the first reference to Udjung Kulon (1861); it is the only exactly specified locality within this reserve which the present author has been able to find in the old literature where these animals may still be encountered today.

Reliable accounts demonstrate that rhino were still being encountered at the following places up to the end of the last century (1865-1900): Mt. Slamet (1867), Mt. Tjerimei (1897), mountains of Preanger (1876), Mt. Papandajan (1881), Mt. Tangkuban Perahu (1870), South Preanger (1877), Tjisitu near Bandung (1866), Telaga Warna, the Puntjak pass, part of the Mt. Gede complex (1880), Wijnkoopsbaai (1880). Around the turn of the century the range must have shrunk to the southern part of West Java, although the Buitenzorg (Bogor) Museum still received two rhino heads as a gift in 1912 which came from Krawang (the plain east of Djakarta), and there is a skin in that museum from the same locality (1910). This material forms the last proof of the occurrence of *Rhinoceros sondaicus* in the northern plains of Java if Udjung Kulon is excluded. The other data available from our century are without exception from the southern plains of West Java, where the last specimen—a solitary bull—was killed south of Tasikmalaja (Karangnunggal district) in 1934 on behalf of the museum mentioned above. Although Schenkel (1969: 99) makes mention of "one individual shot by Franck at Tasikmalaja", he does not add that this was a solitary specimen and supposedly the last

one outside Bantam and that it was killed on behalf of the zoological collection of the Bogor museum where it is still present.

Perhaps the species was not rare locally in the period from 1900 to 1920 in some extremely thinly populated plains of the southern part of West Java, as may be deduced from the reports of such reliable big-game hunters as W. Boreel, J. T. Hamaker, A. R. W. Kerkhoven, H. M. van Weede, D. G. Wolterbeek Muller, etc. But at the beginning of this century Kerkhoven and Lugt (1916) were already writing of the few specimens still occurring in Java, although ten years later Kerkhoven (1926) reports a slight increase along the south coast of Preanger as a result of the absolute ban on hunting that had entered into force in 1910. He states that the Regent (Indonesian Head of the Civil Administration) of Garut assured him that around 1926 there were still about 13 rhino left in his Regency.

In connection with what is quoted below from F. J. Appelman, this estimate seems somewhat on the optimistic side, unless all those rhino were killed in three years' time. In connection with a newspaper story cited by Sody (1959: 151) about E. W. P. Vogelpoel of Bandung finding at the end of 1927 the remains of five rhino, four of which were definitely the victims of poaching, near the south coast of Garut (Tjilaut Eureun), this exceptional poaching pressure in no way seems impossible. Vogelpoel's statement that there were at that time three specimens still surviving in that region tallies well with Franck's experiences a few years later. For Franck (1935) writes that during an investigation made by him in South Garut in 1931 he still found the tracks of two different rhino and there were accounts of a further six living there.

It was also said that at that time a few specimens were still present in South Bantam and large numbers in Udjung Kulon. According to a report received from a chief mantri, or foreman, of the Forestry Service, about 10 rhino were still living in 1931 near Tjibaliung and Mt. Pangasahan, some 50 km east of Udjung Kulon (Sody 1959: 153).

In 1934 F. J. Appelman, then Forester of Garut, stated that the specimen shot in January of that year in the Karangnunggal district (see above) for the Buitenzorg Museum, which was said to have led a solitary life in that region for five years, was the last rhino still living outside Bantam at that time. Although there are a few reports indicating that this information was not entirely correct, it may be assumed—also in view of the lack of any further reliable account of its occurrence in that region—that since about 1935 *Rhinoceros sondaicus* has only been encountered in the Udjung Kulon sanctuary and a few specimens in the adjoining Mt. Hondjè range some kilometres east of that reserve.

The opinion of bona fide hunters from the beginning of this century that the rapid decline of the rhino was due in the first place to the activities of unscrupulous hunters and professional poachers may in general be accepted as correct. As a result of the insufficient attention which the authorities paid to the supervision of game hunting, these hunters could do pretty much as they pleased, being encouraged in this in no small measure by the good prices which Chinese paid for parts of the rhino. However, these bona fide hunters themselves were not always

entirely blameless; for instance, a big-game hunter like A. R. W. Kerkhoven, who definitely belonged to this bona fide category, is reported to have shot nine rhino at the beginning of this century (Sody 1959: 149). And there is no reason to assume that he was the only one of that category of hunters operating around the turn of the century who shot more than the stock of rhino permitted. The bad influence of all of them on the miserable course of events may certainly not be denied.

This influence was exerted in no uncertain manner by people like the Belgian big-game hunter from Africa, Baron Robert de Charcourt, who, according to a British newspaper report, was killed by a rhino which he had hit in North Sumatra. He departed for the happy hunting grounds with the ennobling feeling that he had killed 300 rhino, probably almost exclusively in Africa. The report in question, which bears the title "Death of an Avenger", (McAdam Shirley) contains the following: "Shortly before he died, de Charcourt opened his eyes once more and said with a loud, clear voice to his head boy: 'Mark him down, Latiki. He is number 300...'. It is only to be regretted that such "heroes" lived so long.

It might be adduced as a—not very acceptable—excuse for such behaviour by the bona fide hunters that there was hardly any supervision, so that any rhino which they did not kill would sooner or later have fallen victim to poachers.

Schenkel (1969: 99) writes: "In 1909 the rhino was declared a protected species, yet special permissions to hunt it, were easily obtained, e.g. a Mr. Kerkhoven managed to shoot at least 9 specimens in Ujung Kulon!" In fact those rhino were killed prior to 1909 and there is no proof that after that year special permits to hunt rhino were easily obtained. Most rhino killed by Kerkhoven were not shot in Ujung Kulon; in several other parts of southern Java rhino were not exactly rare in the beginning of this century (see above).

It goes without saying that the enormous population increase in Java—the human population doubled during the first half of this century—with all the attendant consequences for land use, likewise played an important part in this extremely rapid decline. But if there had been satisfactory supervision of compliance with the legal provisions which had been in existence since 1910 and an effective management of the last stronghold of the rhino, the Ujung Kulon game sanctuary, these animals would long have continued to adorn Javanese fauna. When it is recalled that it was possible in Assam, India, to increase the stock of *Rhinoceros unicornis* in the Kaziranga reserve from a few specimens in 1908 to about 150 in 1950 (Gee 1952a), then it must be said that what happened in Java is most regrettable.

An even more striking recovery than that in the Kaziranga reserve occurred with the broad-lipped rhino (*Ceratotherium s. simum*) in the Umfolozi reserve in Zululand (South Africa), with an area of only about 29,000 ha (i.e. about as large as Ujung Kulon). There, thanks to effective protection, it proved possible to increase a stock of about 20 individuals within half a century to over 600 (Schaürte 1960).

As regards the occurrence of the Javan rhino outside Indonesia, including those

in captivity, the author will refer in the first place to what has been communicated on this subject by Groves (1967), Grzimek (1958, 1960), Guggisberg (1966), Krumbiegel (1960), Milton (1963), Reynolds (1960), Sody (1941, 1959), and Talbot (1960). A curiosity is a statement made by Grzimek about an observation of *Rhinoceros sondaicus* in March 1957 in Malaya (Terak). This would therefore mean that the animal bagged by Hubback in Malaya about 1932 was not the last specimen. According to other accounts (Anonymous 1933), the last specimen was shot by A. S. Vernay in Kroh Forest, Perak, in January 1932; it was said to have been an old female, which is now in the British Museum (Natural History). However, Milton (1963) writes: "In Malaya, the last definite record of *sondaicus* was in 1937, when a specimen was shot in the Ulu Bernam area (Selangor)".

Grzimek later wrote (1960) that Dr. E. Lang, the director of the Basle Zoo, had concluded on the strength of a better print of the previously published photograph that the rhino photographed in 1957 in Terak was not a young specimen of *Rhinoceros sondaicus* but of *Dicerorhinus sumatrensis*; this conclusion was based on the absence of the fold in the skin on the neck and that near the root of the tail. However, the photograph reproduced is very unclear as regards these skin folds, whereas what does catch the eye is the clearly visible single, fairly slim horn, without a trace of a second horn; this makes Dr. Lang's conclusion disputable.

In recent years other reports have also appeared on the occurrence of *Rhinoceros sondaicus* on the mainland of Asia. Boonsong Lekagul (1963) reports its occurrence in the Nam Noi and Sai Yoke regions of Kamchanaburi along the western frontier of Thailand, and Nguyen Van Hiep (1963) received reports that both one- and two-horned rhino are still found in Vietnam. *Rhinoceros sondaicus* is said still to exist there in the mountainous regions. Bruton (1963) writes, however: "There are periodic reports of Javan rhinos in Burma, peninsular Thailand and Malaya but these are unsubstantiated". Even if such reports should have a basis of truth, serious doubt may still be cast on the possibilities of reproduction in such cases, where usually one or a few specimens are concerned. The great age which this species can probably reach makes it possible that certain individuals can be reported over several decades in certain regions without contact taking place with fellow-rhino.

Despite the small number of accounts of the occurrence of *Rhinoceros sondaicus* in continental Asia, it is probable that Ujung Kulon is the only spot in the world where this species has still bred in the last decades.

CHAPTER 8

HABITAT OCCUPIED BY RHINOCEROS SONDAICUS IN JAVA
IN THE COURSE OF TIME AND THE IMPORTANCE OF
UDJUNG KULON AS PART OF THE RANGE

It seems a far from simple task to say something reliable about the environment to which the Javan rhino originally felt most attracted in Java. The very first reports which we have available indicate that this was the swampy lowlands of West Java's north coast. But the interior of Java long remained terra incognita, or at least became accessible to the white man much later than the plains, especially those along Java's north coast, which were the very first regions to become inhabited. According to Junghuhn, besides the increasing cultivation of the lower regions, preventing the rhino from living there, it was above all certain species of grass that drew the rhino into the mountains. He repeatedly stresses that such plants formed the principal food of these pachyderms, which—as proved later—is by no means so.

Although it seems difficult to accept that a species of animal can feel equally at ease in the sweltering heat of the lowlands and in the cold of the mountains, with daily temperature differences of 25-30° C, there are instances aplenty to show that this is by no means an exception in the animal kingdom. Practically all the mammals which may be regarded as the big game of Java prove to be highly adaptable in this respect, with the possible exception of the banteng, whose occurrence at a height above 300 m is not known to the present author, though Junghuhn mentions this game from regions up to 2,000 metres. Junghuhn's statement that the rhino is the only large mammal to live constantly on the highest peaks of mountains is not correct; the barking deer and the panther are also known to do so, whilst deer and wild boar lived in large numbers in the Ijang Highlands, which are some 2,000 m above sea-level. It is probable that the wild boar locally belongs to the regular visitors to the highest peaks of Java and that the Javan deer is not deterred by such heights either.

As the rhino had long disappeared from all the volcanoes of Java when there were still enough specimens in the southern plains to maintain the species for a long time, it seems obvious to assume that these mountains were not the habitat to which the species was the most attracted, although the "trenches" made in a number of places do point to a lengthy or at least regular visit by these pachyderms. For the author, who has climbed to the top of practically every major volcano where rhino once lived (Sanggabuana, Salak, Gede-Pangrango, Tangkuban Perahu, Papandajan, Galunggung, Tjerimei and Slamet), there is no longer any doubt that these animals would have been able to maintain themselves much longer on the desolate slopes of these largely uncultivated and uninhabited moun-

tains if they had originally lived there in sufficiently large populations and these mountains really represented the suitable range.

It is not clear why the species disappeared so much earlier from these mountainous regions than from the lower zones along the south coast of Java, but it is probable that the population living on each of these volcanoes was not viable after the lowlands separating these mountains became cultivated and were no longer accessible to rhino. However, a quarter of a century ago—and it is probably still so today—there were in the wild mountainous regions of central and southern West Java continuous or almost continuous stretches which contained no or hardly any human settlements, which were no smaller in area than Udjung Kulon and where the difficulties of hunting rhino were perhaps even greater than inside the latter area. The extensive Mt. Hondjè range, which begins a few kilometres north-east of Udjung Kulon, has in the author's experience only a very slight attraction for rhino; they rarely penetrate this range to any great height, although they have probably been living for centuries in nearby Udjung Kulon. This too may be regarded as an indication that they do not prefer such mountainous areas. The Mt. Hondjè range is not mentioned in the old literature as a home of these animals, nor is the Mt. Pulasari—Mt. Karang range further to the north, in which the author did not find anything to suggest that the species formerly lived there either. Furthermore, the extensive Mt. Pajung range inside the Udjung Kulon reserve definitely does not enjoy the preference of the rhino.

In view of the above it seems justifiable to express the opinion that only certain parts of the Javanese mountains were attractive to the rhino, though definitely not essential, but that the animal, generally speaking, could never do without the lowlands. It is not impossible that the visit to volcanoes was for the purpose of enjoying sulphurous wallows or of benefiting in some other way from the chemical substances to be found in the vicinity of points of volcanic eruption, on which, however, their survival definitely did not depend.

On the other hand, the facts that at first it was almost exclusively reports from the vicinity of old Batavia that spoke of an abundance of rhino, and that it was not until much later that their occurrence along the south coast became known, may not form any reason for thinking of a preference for the northern plains. For the south coast of Java did not become better known until much later, so that our first information on the fauna living there is also of much more recent date.

The disappearance of rhino from the north is much easier to explain than that from the mountainous regions, since the enormous growth in population had to be housed mainly in these plains with as its consequence a tremendous elimination of habitat, so that there was soon no room left for big game.

It is not possible to give a description of the botanical and other characteristics of the habitat to which rhino were most attracted two or three centuries ago outside Udjung Kulon. Probably such areas still exist where the situation is more or less analogous to the one in those days; this certainly applies to the mountains and some regions along the south coast, but a closer study of these has little point, since it is absolutely unknown whether rhino were in permanent residence there

in the past. From more recent periods something is known about the environment in which rhino lived, but the data available on this are too superficial to form the basis for a judgment.

When discussing the habitat preference of *Rhinoceros sondaicus* in Java, Groves writes (1967): "On the whole, authors tend to confirm the opinion of Peacock, that the Javan rhinoceros tended to exist more on low ground. Indeed, when one plots the localities of the two onto a map showing altitudes, this tendency is revealed. It is, however, only a tendency." The present author agrees with this.

In connection with what has been said above, the author does not believe that the Javan rhino was finally "driven" to its present habitat. Ujung Kulon has probably long contained the biotope excellently suited to this species. It must also be due to this that *Rhinoceros sondaicus* has been able to survive there up to the present day. The terrible onslaught by poachers on the rhino supply in and near that sanctuary in the past half-century makes it reasonable to assume that around 1920 no less than 50 to 75 individuals were still living there; such a number can certainly only have come into being inside a territory offering optimum conditions, when one considers the relatively small area of the reserve (almost 30,000 ha) of which, moreover, only certain parts are suitable for these pachyderms.

The following may be said with regard to the habitat to which rhino are attracted inside Ujung Kulon, reference being made to Chapter 5.

Although beyond the real tidal forests there is hardly an area covering much more than one hectare in this reserve where a rhino will not appear now and again, it may be said that preference is given to the lowest zones extending along the entire coast, including the extensive boggy region near the eastern boundary. Of the greatest importance to these pachyderms is the belt of vegetation which is so difficult for human beings to traverse and those parts of the reserve where the mangrove swamps pass into the shrub jungle and forest of the drier regions. The parts of the rhino's most suitable forage habitat which are easy of access to man are almost exclusively visited at night. Encounters with these animals rarely take place in daytime outside a dense scrub jungle or almost impenetrable thickets of rattan, salak, bamboo, Zingiberaceae, etc.

The rolling hills of the interior are of less importance; there are large areas in that part where rhino seldom come, though there are quite a few wallows pointing to more frequent visits in bygone periods when the rhino population was denser. These parts of the sanctuary in which the vegetation has reached more or less a climax, or in any case did not display any evidence of changing its composition during the author's period of investigations, often strikes the human visitor as not being particularly attractive to most of the other large mammals either. During a trip made by the author in 1954 through this central hill country, he wrote in his diary on 19 November that for the third day in succession he had seen no game! If such a thing happened for *three hours in succession* in the area of coastal lowlands it occasioned surprise.

The map published by Schenkel (1969: 122) "indicating concentrations of rhino traces" shows a different situation than established by the present author

who found the rhino fairly equally distributed over the lowest parts of the reserve, especially in the Niur-Njewaän area, and along the Tjitelang, Tjikarang, Pemageran, Tjigenter and Tjihandeleum rivers. Besides there were many proofs of the animal's regular occurrence in the Tereleng peninsula and in the country north of it up to the tidal forests of the Pamagangan area, and also in the coastal plains along the western part of the Mt. Pajung range. In or near those locations optimal conditions are present for these pachyderms; therefore, the present habitat preference indicated by Schenkel seems to be strange.

For their food the rhino are largely dependent on shrubs and saplings (Plates 34-37), almost exclusively to be found in the regions principally covered with a secondary vegetation, inclusive of the margins of the heavy forest, and it is a sufficient supply of such types of plants which must remain available. If the number of rhino has fallen to such a low level that the maintenance of the suitable forage areas (see also Chapter 14) becomes insufficient, human interference is inevitable but in the author's opinion the necessity of such measures is not present for the time being.

This opinion is apparently shared by Talbot (1964), for he writes: "There is no immediately obvious lack in the habitat or food supply. The only obvious factor at this point is poaching".

CHAPTER 9

LEGISLATION

In September 1747 the authorities in Java put a bounty of 25 guilders—which was certainly a large sum for those days—on the killing of a rhino.

Although as from 1 January, 1751, a hunting ban was proclaimed for the months of March to October inclusive, wild boar, tigers and “other devouring animals” were excepted from this. Since in those days the rhino was also placed in the latter category the hunting ban did not apply to rhino either.

Even in 1832 S. Müller still reported a premium of 16 guilders for the Preanger Regencies. Much later, in the period 1864-1870, these animals were regarded as very harmful to the quinine plantations in the vicinity of Mt. Tangkuban Perahu in West Java, whilst as late as 1892 a British sporting paper (quoted in *De Indische Mercur* 15, 1892: 255) and in 1896 a guide-book published by the Koninklijke Pakvaartmaatschappij (a Dutch shipping company) propagated the hunting of these pachyderms in Krawang and South Preanger. Although these and numerous other reports (see also Chapter 7) indicate that rhino could not be described as rare in West Java in the second half of the last century, at the beginning of our century it became clear that protective measures would be required to prevent the complete disappearance of this species.

As one of the first steps to restrict game hunting in Java must be considered the prohibitions promulgated in 1908 (Official Gazette of the Netherlands Indies No. 100) on hunting and the carrying of firearms in the State Forests without a permit; however, the maximum penalty for infringing this ban was a fine of only f 25. These forests comprised all the Government's teak forests and other woods exploited for economic purposes, including those designated as such by the Residents (European Heads of the Civil Administration). Later this provision was abolished again, although permission to use a firearm when hunting in the State Forests remained tied to a permit from the Head of the Civil Administration; strangely enough this was not allotted to the local foresters, who were in charge of such forests.

These regulations related only to a small part of Java—the State Forests—but they were soon followed by the promulgation of legal provisions for the protection of wild animals living in the Netherlands Indies (Official Gazette No. 497, 1909); as from 1 July, 1910, they were declared to be applicable to the whole country. By these provisions all wild mammals and birds were fully protected, with the exception of a number of species regarded as harmful, in which a distinction was made between those living in Java and Madura and those occurring on the other islands. Although the Javan rhinoceros received complete protection in Java, the “rhinoceros animals” outside this island came in the category of species with regard to which the Resident could suspend the protection.

Since, after these regulations became operative, not only the trapping and killing of these protected species were prohibited but also possession thereof or of parts of their bodies, these measures would have meant a big step in the right direction if they had been properly enforced. But the general impression was that their actual effect was particularly small and that they did not obviously retard the decline of the species which they were meant to protect. For instance, it was still possible in 1912 for an advertisement to appear in the German paper “*Zoologischer Anzeiger*” recommending the hunting of rhino in Java (“Jagd auf Tiger, Rhinoceros, Wildbüffel, Krokodil, undsowweiter”). A Public Prosecutor visiting Udjung Kulon for big-game hunting in 1913 (p. 12), published the fact that one of his native guides had killed 11 rhino and sold them to a Chinese in Labuan without it apparently entering this official's mind to prosecute these gentry.

Nor could the maximum penalty for infringement of this Ordinance be considered to have much of a preventive effect, amounting as it did to only a fine of one hundred guilders or eight days' imprisonment.

How rhino were “protected” outside Java is demonstrated by the profusely illustrated articles which appeared in various periodicals from the pen of an ex-officer in the Royal Netherlands Indies Army, J. C. Hazewinkel (1925, 1932, 1933), in which he stated that in less than one year's time (1925-1926) he personally killed seven *Rhinoceros sondaicus* in South Sumatra! Later investigations have indicated that in all probability this slaughter meant the end of this species of rhino in Sumatra. Hazewinkel received the sum of f 2,000 for the largest horn, which was about 37 cm long, and he says that in those days the hides brought in f 1,000 to f 1,500. Compared with these amounts, a maximum fine of f 100 for killing such an animal sounds like a bad joke. From correspondence exchanged with Hazewinkel in May-June 1965 it emerged that these rhino were killed without any permit, or in other words illegally, and that the animals killed included a mother with calf. It is remarkable that this was never investigated, not even when a detailed article written by the hunter himself was published in the well-known journal of natural history, *De Tropische Natuur* (Hazewinkel 1933). Even more surprising is the fact that this same hunter was given a special permit in 1933 by the Department of Agriculture, Industry and Trade (under which the affairs discussed here then fell) to shoot two *Rhinoceros sondaicus* in Sumatra on behalf of the Zoological Museum at Buitenzorg. The criticism of this voiced by De Voogd (1933) was fully justified, since at that time it was not known in the slightest how many of these animals were still extant. However, Hazewinkel did not succeed in making use of this permit, as far as is known officially. Schenkel (1969: 99) writes: “Sumatra: 1925-1930 most probably 12 individuals were shot by Hazewinkel in the Palembang region (S. Sumatra)”. In fact there is no proof that Hazewinkel killed more than the seven animals indicated above.

It also becomes evident that the authorities in Palembang were not so particular in the 1920's about what happened to rhino when a report is considered in the *Nieuwe Rotterdamse Courant* of 3 July, 1927, to the effect that Hagenbeck's representative in South Sumatra was offering young rhino (in addition to

many other species of animals) for sale at 1,200 to 1,600 guilders a piece!

Although it had been the intention of the legislator, by enacting the Game Hunting Ordinance 1924 (Official Gazette No. 234), to bring about an improvement in the not very satisfactory situation in those years, this was only a partial success. The chief cause of this failure was the fact that the provisions of Section 30 that the Ordinance would be declared applicable to the provinces outside Java at a date to be fixed by the Governor-General were never implemented, so that on those islands the Ordinance of 1909 remained valid. But, as far as the rhino were concerned, making the provisions operative outside Java would definitely not have meant an unrestricted improvement, since in the list given in Section 5 of this new Ordinance among the species to be protected on those islands *only* the Sumatran and *not* the Javan rhino was mentioned. (The Ordinance of 1909 speaks of rhinoceros animals, i.e. covering both species). It is incomprehensible why absolutely no allowance was made for the occurrence of *Rhinoceros sondaicus* outside Java when the Ordinance of 1924 was drafted, although S. Raffles in 1822, J. C. Koningsberger in 1902 and H. O. Robinson and C. Boden Kloss in 1923, among others, also reported this species of rhino as occurring in Sumatra. Moreover, as far back as 1876 the subspecies *floweri* was described for this island. Consequently, not a single protective measure would have been applicable to the Javan rhino in Sumatra if the Ordinance of 1924 had in fact become legally valid outside Java and Madura.

The possibility of suspending, for game hunting purposes, the prohibitory provisions with regard to the animals listed in Section 5 of this Ordinance as far as adult males were concerned (including the Sumatran rhino) for a period not exceeding six successive months in the regions outside Java and Madura by the European Heads of the Civil Administration did not mean a real improvement. This should have made it possible in those regions to obtain a permit valid during six successive months, for which f 150 had to be paid, to shoot an unlimited number of adult male Sumatran rhino.

The introduction of a hunting fee and the restriction of the period during which the prohibitory measures could be suspended were improvements, but in the new regulations the Sumatran rhino was expressly made a game species for which it would have been difficult to refuse a license. This was not the case in the Ordinance of 1909 which enabled the Authorities to suspend the prohibition only in case of emergency. For all these reasons it was a fortunate circumstance that the protective measures promulgated in 1909 remained valid for the regions outside Java and Madura.

As regards Java, the Ordinance of 1924 did not mean any improvement for the protection of rhino living there either; in fact it implied a deterioration, since in 1909 the ban on being in possession of hides and other parts of the body was subject to no restriction, but in 1924 applied only to *fresh* parts. Another drawback was the fact that possession of parts of a body belonging to a Sumatran rhino shot outside Java was no longer an offence *in Java*, since in this island such a ban applied exclusively to *Rhinoceros sondaicus*. One improvement was that the maximum penal-

ty was raised to a fine of f 500 or a term of imprisonment of three months, which could be doubled on account of certain aggravating circumstances.

It was not until 1931 that the situation improved and also a stop was put to the treatment of such different matters as nature protection and game hunting in one Ordinance. In the Animal Protection Ordinance and Regulations 1931 (Official Gazette Nos. 134 and 266), which applied both to Java and the other islands, an improvement was made to the highly unsatisfactory situation that, by order of the Head of the Civil Administration, the hunting of rhino could be permitted on the islands outside Java and Madura. Although in these islands the issue of a hunting permit became possible, the list of seven species referring to such a licence did not include *any* rhino. A deterioration was the fact that the list did include such valuable and partly rare species as the elephant, the banteng, the dwarf buffalo (anoa) and the babirusa (hog-deer from Celebes), that the hunting period of six months, valid for these four species, was extended to a year for Javan deer, barking deer and kanchil and that the permit was free of charge.

An improvement was envisaged by prohibiting the possession of hides or other parts of the body of the protected species without any restriction whatsoever (as had already been the case in 1909, by the way), thus also making the possession of non-fresh parts of the body and of products made from such parts an offence. In addition there was a ban on trading in and exporting such articles.

Now, at last, there was—at least on paper—an almost “watertight” protection of the two species of rhino living in Indonesia. A few years after the Animal Protection Ordinance and Regulations 1931 had entered into force, a start was again made with the drafting of a new Ordinance, which was to be given the name of Fauna Protection Ordinance. But the outbreak of the Pacific war prevented its being promulgated in the Official Gazette.

As regards the protection of rhino—which could be described as almost perfect on paper—the latter draft Ordinance aimed at bringing about improvement only in that it created the possibility of confiscating *all* means which had had anything at all to do with a clandestine hunt discovered. This would also include all non-public means of transport, also if not the property of the offender (including boats, motorcars, etc.) which had played a part in such an offence, which was, of course, especially important in cases of rhino poaching.

The draft of this new Ordinance again demonstrated what endeavours were being made to perfect the protection of wild animals on paper. But it was insufficiently realized that the authorities charged with enforcing it were entirely incapable of keeping up that perfectionism and also lacked the mental preparation for doing so. Also because the Government was deficient in providing the means for a satisfactory enforcement of the statutory provisions, the practical results continued to be almost nil.

After the transfer of sovereignty of Indonesia in 1949, the existing regulations in the field of nature protection and game hunting were maintained unamended. Attempts to increase the penalties, by making the killing of a rhino a misdemeanour instead of an offence, had no greater success than they had had during

Dutch administration. An Emergency Act drawn up by the present author with the assistance of two lawyers in 1951 was never declared operative either; this Act aimed among other things at transferring further powers of the Civil Administration to the Ministry of Agriculture, under which the matter discussed here fell.

To sum up, it may be said that, despite all protective measures, the drastic decline of rhino continued almost unabated. The economic difficulties with which Indonesia has had to content for many years now will accelerate the disappearance of these rare animals; at any event it is the author's opinion that *Rhinoceros sondaicus* in Java has never been so close to the end of its existence as must be the case now.

The fact that, despite the years of persecution, rhino still occur on Indonesian territory must be ascribed almost exclusively to the circumstance that penetrating into their habitat usually makes extremely high demands of the courage and physique of their human ensnarers. But the constantly growing ingenuity which enables man to make his way without much personal danger to the most inaccessible parts of the earth hardly gives these animals any chance of survival.

CHAPTER 10

POACHING PRESSURE AND ITS BACKGROUND

As has repeatedly been stressed above, the series of protective measures in no way put a stop to the poaching of these animals and the illegal trade in the products made from them. In the provinces outside Java it was in any case not until 1931 that the rhino living there enjoyed unrestricted protection, no longer dependent on the divergent views of the ever-changing Heads of the Civil Administration.

There is no point in indulging in speculation regarding the number of rhino which have fallen victim to poachers in Java since the hunting of these animals there without a legal permit was completely forbidden in 1910. Nor are reliable figures available on the first decade of this century, when hunting was almost entirely free. Besides the few bona fide hunters in those days who are known to have shot rhino, there must have been an unprecedented number of unscrupulous ones and professional shooters (see also Chapter 7).

When Udjung Kulon had become in the early 1930's the only area where *Rhinoceros sondaicus* still managed to survive, this did not put a stop to the merciless pursuit. It may be assumed that in the period 1930-1937 not a year went by without rhino inside Udjung Kulon falling into poachers' hands. For instance, in October 1931 a number of Chinese succeeded with the aid of 80 Indonesians in shooting three rhino. What happened in that same year in the field of the administration of justice was perhaps an exception. For the District Judge of Menes (Bantam, West Java) discharged on "legal grounds"—quite wrongfully, by the way—a Chinese poacher, who in 1929 had killed two rhino in Udjung Kulon. Later this poacher—probably encouraged by this magnanimous treatment—again went after rhino in the reserve. As the man was particularly aggressive, the military had to be called in to seize him there. They succeeded only after a gun-battle! The series of offences with which he was charged made it possible to impose on him a long term of imprisonment, which was duly done.

As already stated in Chapter 2, the extensive stretches of alang-alang caused and maintained by regular burning-off encountered by P. F. Franck in the period 1928-1931 opposite Pulau Peutjang must be regarded as proof of poaching of ruminant game inside Udjung Kulon. This was confirmed by F. H. Endert after a tour to the reserve in July 1931; in addition, he found poachers' butts and even a meat-drying shed (Endert 1931).

Indications of poachers' activities were also found in August 1934 by J. S. de Kanter, the retired Head of the Civil Administration of Bantam, who visited Udjung Kulon to hunt tigers: a tree-hut above a rhino spoor near the Tjitelang and a camping site of about six poachers upstream of the Tjikanrang. In October 1932 De Kanter also stated that in a 12-month period the police solved nine rhino poaching cases! In particular the introduction shortly before of a bounty system

for reporting clandestine hunting parties was supposed to have led to this success.

The greatest scandal was revealed by the startling report of the then Head of the Civil Administration of the Pandeglang District, J. C. Ligtvoet (1936), who in admirable fashion threw a light on what was probably the greatest slaughter of rhino ever to have taken place in such a short period up to then. Under the leadership of a Government official of the Civil Administration, an Indonesian, a gang had succeeded in killing 15 rhino in the period from October 1935 to April 1936 (though the report does not conclusively demonstrate that it was in fact such a large number of recently killed rhino).

As already stated in Chapter 3, in February 1939 the activities of a European poacher inside this reserve again cost the life of two rhino, a cow accompanied by a calf. In October of that same year five Indonesians were again caught in the act of transporting parts of the body of a freshly shot female rhino somewhat to the east of the sanctuary, and in 1943 remains were again found of a similarly poached animal inside the reserve. They lay near a mudhole not far from the north coast which was visited at regular intervals by these animals. This was along Legon Penju, a place where it is easy to land in any month of the year, even by small proa.

For the period from 1946 to 1950, which was a very chaotic one, there are likewise indications that at least five rhino fell into poachers' hands. After the transfer of sovereignty in 1949, by which Indonesia became entirely independent, over 40 persons were charged with this poaching and a number of firearms and parts of rhino were confiscated. It is not known to the author whether these cases were ever tried (though this had still not happened by 1957); the offences had been committed before the transfer of sovereignty, which seemed to make the matter particularly complicated. The large numbers of arms and quantities of ammunition which had entered into the hands of the population immediately after the Japanese capitulation and the fact that in the years preceding the transfer of sovereignty Ujung Kulon was in a zone with an administrative vacuum probably meant a greater threat than the rhino had known during many years.

According to Kusnadi P. Satmoko (1961), no rhino poaching occurred in the period from 1950 to 1960, but a rhino skeleton found in 1955 near the south coast of the reserve, which was examined by the present author, was with a fair degree of certainty that of an animal shot illicitly. And about that same time a case of poaching outside Ujung Kulon was solved; the remains of that animal, too, were found in the Aermokla area, just east of the reserve.

A report written in October 1964 by the American biologist Lee M. Talbot, shortly after a visit which he had paid to this sanctuary, makes it evident that the poaching has definitely not come to a stop. The report states that in Ujung Kulon and vicinity thirteen rhino have again been killed in the preceding decade. If the two specimens mentioned above as shot in 1955 are subtracted from this total, there would be eleven new cases. In a letter from the French biologist P. Pfeffer dated 27 April, 1965, the author was informed that officially six rhino were killed in one single year. Pfeffer likewise visited Ujung Kulon towards the end of 1964. Although Verschuren (1967) writes: "Numerous rhinos were killed up to 1963 or

1964, but it seems that no animal has been killed since that time", Schenkel (1968) reports the killing of at least one rhino again in 1967.

Since all the above cases are only those which were solved or are instances of poaching of which evidence was found, it may be assumed that in reality a much larger number of rhino have been murdered since 1929 than the 42 of which there is proof. This figure of 42 was obtained by assuming that the nine cases mentioned by De Kanter in 1932 included the five rhino killed in 1929 and 1931. At the same time the number of 15-16 stated by Ligtvoet was reduced to 10, since it is not entirely out of the question that the remains found included parts of the bodies of specimens killed earlier. And no mention is made of the period between 1921—when Ujung Kulon was declared a nature reserve—and 1929, about which practically nothing is known, since the attention paid to the reserve in those years was nil.

This annoying series of cases of poaching is of course attributable in the first place to the lack of effective surveillance, in particular during the period 1921-1937 and again from 1957 up to the present. Moreover, countless examples could be quoted illustrating that the authorities hardly bothered—if, indeed, they troubled themselves at all—to see to it that the statutory enactments were properly complied with, also outside the sanctuary. As stated above, a Chinese poacher who killed two rhino in 1931 was acquitted on "legal grounds". In Pontianak, Borneo, in 1934 the magistrate sentenced a Chinese found in possession of parts of a rhino to a fine of one guilder or one day's imprisonment.

In July 1938, after the administrative machinery had been jerked into motion by the scandalous cases of poaching revealed by the Ligtvoet report in and around Ujung Kulon in 1936, an extensive investigation was instituted into the illicit sale of products made from parts of rhino, especially "medicines". This led to the shameful discovery that business in such "medicine" was flourishing undisturbed. An investigation made at Sukabumi (West Java) indicated that almost all the many Chinese druggists there were offering rhino products for sale; it is true that many of these proved to be made from parts of the horns and hides of buffaloes and goats, but this did not become clear until serious laboratory investigations had been made. After the Attorney-General's office issued a circular in 1938 about this illicit trade, much material of this kind was confiscated, and some fines were imposed amounting to f 150—f 350. Almost daily such ingredients arrived at the Zoological Museum at Buitenzorg (Bogor), where their identity was established. It may incidentally be added that a similar circular distributed in 1951 by the Indonesian Ministry of Agriculture on a large scale among the authorities which might conceivably have anything to do with such matters did not yield a single tangible result. Obviously in those days the bodies and persons entrusted with supervision had very little interest indeed in this work. It seems most unlikely that there has been any change for the better in the last decade. This may be demonstrated by the fact that in 1962 the author received an advertisement of a well-known American animal-dealer, who, besides birds, tigers, leopards, elephants and buffaloes, offered for sale the strictly protected tapir and rhino. The photo-

graph illustrating this advertisement is of a Sumatran rhino, captured in May 1958 in the Kurintji District, Sumatra.

In Batavia in 1938 there was a dealer in products made from parts of rhino who did not try in the least to keep his activities secret, for he widely distributed striking advertising leaflets. These sang the praises of the exceptional quality of an oil extracted from parts of rhino. No household should be without a bottle of this "medicine", costing f 0.50 per 10 grams and f 0.90 per 20 grams, for it could cure the most widely varied diseases and complaints. In bold letters the leaflet swore that the "medicine's" origin was genuine and warned against imitations. Beside the portrait of the "medicine man" of Minangkabau, Datuk Sidi, who compounded this magic remedy, a list of names and addresses of a whole series of representatives appeared. These were scattered over the whole Archipelago, from Atjeh to Semarang. But the most surprising feature of this leaflet was the picture which it contained of the Javan rhino shot in 1934 near Tasikmalaja on behalf of the Zoological Museum at Buitenzorg, also showing the hunter and taxidermist of that museum and well-known conservationist P. F. Franck, and a Sundanese skinner! It was a reproduction of a photograph printed in *De Tropische Natuur* in 1934. All this was possible almost 30 years after it had been forbidden by law.

But another 20 years later, in 1950, the editors of a well-known newspaper in Bandung proved to be entirely unaware of the legal regulations appertaining to rhino, for an advertisement was published in it offering to buy rhino (badak) horns.

Shortly after the transfer of sovereignty in 1949, it looked as if interest in parts of rhino had very much decreased, reaching its nadir in 1959 in connection with the economic measures against the Chinese section of the population, but the demand increased again about 1961, so that, as we saw above, in Java alone again several rhino fell victim.

So much has already been written about the background of the incessant pursuit of this animal, long after damage to growing crops or destruction of other human property could not be blamed on it any more, that it would be repetitious to devote an exhaustive discussion to them here. Consequently only a summary will be given of what other authors have already written on the subject, supplemented by a number of previously unpublished details from the present author's own records.

Heynsius-Viruly and Van Heurn (1935: 45-46) state: "It is generally known that the hunting of the rhino is very much stimulated by the great value attributed to almost all parts of the rhino's body, and to the horn in particular. This high esteem in which Orientals hold the rhino horn is due to the centuries-old belief that this material has special, more or less magic powers regarding the human body. Rumphius already describes this in his *'Amboinese Rariteitenkamer'* and pokes fun at it.

These powers are said to manifest themselves in three forms: 1. a medicinal or curative effect in cases of snake-bite if a piece of the horn is placed on the bite; 2. a reaction to poison in drinks: if the drink is poured into a beaker of rhino horn, it

will begin to foam; 3. an aphrodisiacal effect if the horn is consumed in powder form or dispersed in water. Belief in effects 1 and 2 is universal from Arabia to China and Japan. One of the principal markets for rhino horn is Bombay. And the fact that Eurasians and Europeans not infrequently share this belief as well is borne out by a letter from P. W. Hofland, Pasuruan, reproduced by the *Tijdschrift voor Nederlands Indië* (1846).

This problem has been studied on several occasions. A good literature list on it has been compiled by J. Kreemer Jr. (1914). The prevailing opinion is that the effect is nil or a matter of suggestion, and that belief in it must be put on a par with that of our forefathers in the corresponding powers of the narwhal (*Monodon monoceros*) tusk. Little is so far known about effect 3 of the rhino horn, i.e. as an aphrodisiac. Since, however, in recent times our knowledge of the chemical composition of estrogens has greatly increased—they belong to the group of the steroids and derivatives thereof—it will be possible to establish in the foreseeable future whether the alleged effect tallies with the chemical composition".

Bruton (1963) remarks: "Research on the rhino horn in Thailand has yielded nothing which would indicate that the horn has any medical value". On this point Gee (1964) writes: "In chemical research laboratories in Basle it has been conclusively shown that rhino horn has no biochemical or hormonal properties whatever".

Sody (1959: 225) still speaks of a "valuable salt" that was compounded in the 18th century from rhino hide and of the great medicinal value attributed to the blood, both fresh and dried. Quoting A. R. W. Kerkhoven, he also mentions the magic powers ascribed in Java to "two small blunt teeth lying between the canine teeth", known as "menur" or "menenur". J. C. Hazewinkel even calls the undigested contents of the stomach medicine, whilst Gustav Schneider found in Sumatra that these stomach contents were cooked and eaten by Chinese.

To the Chinese druggists in Indonesia the principal ingredients produced from rhino are known under four different names, viz. Sie Kok (Kak) Sze if they come from the hooves, Say Goe Phwee if they are from the hide, and Say Kak or Say Goe when they originate from the horn (Plate 43). Although these articles are recommended as specifics for leprosy, skin complaints and venereal disease, and also as styptics and antipyretics or for restoring to the old the powers of the young, the advertising leaflet mentioned above claims that the oil recommended in it can be used to remedy literally every ill from which mankind can suffer and is suitable for both internal and external use. This "cure-all" can be applied to remove thorns, needles, etc., stuck in the flesh or even a fish-bone caught in the throat, but also against deafness, toothache, belly-ache and stomach-ache, and against rheumatism, kidney trouble and sore eyes. However, it is equally suitable for helping little children who are too weak to walk to take the first steps and for curing a sick chicken (the nature of the sickness seems irrelevant!). But a footnote printed in boldface points out that the medicine may definitely not be taken by pregnant women. The fact that in so many cases in that leaflet the recommendation is followed by the words "if it is Tuan Allah's will" does not sound particularly reassuring.

Gee (1964) states that the horn, placed under the bed of a pregnant woman, alleviates the birth-pangs. He adds: "Persons owning a horn would rent it out to expectant mothers for the equivalent of about £ 30 each time! Yet another absurd belief was that a rhino horn left to soak in a filled bucket turned the water into a sort of elixir of life, of which members of a family would sip a spoonful every day!"

There need be no doubt that such "medicines" are regularly demanded by practically all *Oriental*s and perhaps also by a not inconsiderable number of Westerners, so that it is by no means possible to meet this demand any longer by authentic rhino products. The result of this is, of course, that by far the greater part of the "medicines" marketed under the above names are imitations. The material confiscated and examined at Buitenzorg in 1938-1940, which came from almost every part of Indonesia, consisted for the greater part of thin slivers of buffalo hide and horn (Plate 43).

In view of the great demand for this so-called medicine, almost everywhere in the East, it is rather strange to find that in a previous paper Gee (1958) passes over this entirely and is of the opinion that the demand comes from China. For he writes: "Only two rhino each year seem to be lost in Kaziranga through poaching, and it is possible that the market for rhino horn has been affected by conditions in China during the last decade". Also Schenkel (1969: 99) writes: "Nowadays, the rhino is only persecuted for its horn, skin and blood which are still sold in China as medicine, especially as a charm of supposedly aphrodisiac action."

The present author is of the opinion that the interest in this "medicine" is certainly not restricted to the Chinese and doubts whether the political situation in China plays a part in this. Probably the role of the Chinese "medicine-men", who have settled almost everywhere in the East, would also be taken over immediately by others if the Chinese were obliged to cease these activities, as is increasingly the case in Indonesia. Gee also seems to think—as may be deduced from the above quotation—that only the horns are important, which is definitely not so, although they do have the greatest value.

In view of the above, it may be regarded as out of the question that the protection of rhino can be successfully undertaken anywhere else than in the places where they still live, an opinion with which everyone who knows the East from personal experience will concur.

The horn, borne by the male rhino, seems to have had the greatest value at all times. It differs considerably from the horns or antlers of any other species of animal because it consists—to put it in popular terms—of a compact mass of hair grown together on the hide of the head—in other words loose from the skull—which, once removed from the hide, displays a slight hollow.

Whilst in Old China special properties were already attributed to the rhino as an animal, the horn headed the list of Chinese medicines, the summum of magic influences being ascribed to it. This part of the body became the most costly material for ceremonial goblets out of which wine was drunk when taking an oath or swearing fidelity to one another, but also an indispensable medium for

identifying a poisoned liquid, with which, in old China, it was the custom to dispose of one's enemies. But according to Hubback (1939) who gives many particulars on the importance attributed to the horns of rhino, the uselessness of this medium to identify a poisoned liquid was published as far back as 1840.

It is understandable that great care was devoted to such horns, and this has been the case in China through the ages. Casal (1938) states that the Shōsōin Treasure House at Nara, in Japan, contains goblets which were shaped with great workmanship from these horns as far back as the beginning of the 8th century. In the second half of the 13th century there was in China an Imperial workshop in which 150 craftsmen did nothing else but make objects from ivory and rhino horns. The paper in question contains illustrations of a large number of these goblets; they display the most varied figures and scenes, from lotus and magnolia blossom and leaves and other plants and trees to almost faithfully depicted scenes of gardens and mountainous landscapes, often with ornamental waters and boats sailing on them, together with Buddhistic emblems (Plate 42). It was the craftsman's pride to retain as much as possible of the original horn and to adapt the decorations entirely to its natural shape, so that the horn always remained immediately recognizable.

In later periods the horns acquired a more decorative or symbolic significance. The constant reduction in the number of these horns finally led to growing scepticism regarding their magic powers. Towards the end of the 18th century they had already lost almost all of their old glory. But the great fame of the horns, originally confined to China and India, had spread over much of Asia and Africa; unfortunately this has remained so up to the present day, as with almost all the other parts of the body and also the blood of this poor animal, sacrificed on the altar of superstition.

CHAPTER 11

ESTIMATED STOCK IN PAST AND PRESENT.
DIFFICULTIES IN TAKING STOCK

It need surprise nobody that the number of Javan rhino still extant, whose extermination was already assumed as far back as half a century ago to be only a matter of a few years, has many times been the subject of discussion.

There is no point in reviewing all these estimates here, since in general they give the impression of having been made without any serious local survey. In most cases they were even proposed by people who had never visited the reserve. It is, however, surprising that well-known big-game hunters, who knew the sanctuary from personal experience, such as F. H. Elbers and A. J. M. Ledeboer, also differed so greatly in their ideas of the number of rhino still living in Ujung Kulon around 1930: the former estimated this number at 100, the latter at 5. Having regard to the large numbers shot since then, including about 20 in 1929-1936 (see also Chapter 10), the latter figure could not, of course, have been correct.

After an extensive survey in the whole sanctuary, the present author estimated their number in 1937 at 20-25, and around 1955, after numerous visits, at 30-35. As in the period 1937-1955 at least 10 rhino fell into poachers' hands, the estimate made in 1937 was probably a little too low.

After a survey performed at the end of 1964 by Lee Talbot a figure of 47 (38-56) was stated, the number of rhino officially known to have been killed in the preceding decade being given by him as 13; this means that in about 1954 there would have been about 47-50 specimens in the reserve when putting the annual increase at one calf (Chapter 16).

Schenkel (1967) estimated the rhino population in this sanctuary to be 21-28 individuals in 1967 (see also Anonymous 1968) and 19-29 in 1968. Later (1969: 129) these estimates were changed in 24-25 and 25-26 respectively, among which no fewer than 8-9 and 5-6 immatures below the age of 2 years.

Bengt Berg (1933), Gee (1952^a) and Shebbeare (1953) have all pointed to the great difficulty of making a satisfactory census of *Rhinoceros unicornis*, which lives much more in open terrain (also during daytime). It therefore need hardly be stressed how awkward it is to perform such an inventory for the Javan rhino, living as it does in so impassable and complex an area as Ujung Kulon.

Although great value may certainly be attached to the measuring of rhino spoor for inventory purposes, the importance of this method depends primarily on the critical faculty and the experience of the man doing the measuring. It is often extremely difficult, and in certain cases absolutely impossible, to say for sure whether a track was left an hour or a day before. In view of the large distances which these animals can and in fact do travel in a short time and the numerous prints which may be encountered within a relatively small area, it often may be a practically

impossible task even for insiders to say for sure which animal is concerned, or whether tracks found in the afternoon were or were not made by the same animal which left those prints in the morning or in the preceding night.

Furthermore, mistakes can all too easily occur when measuring the footprints (see also pp. 83-85). The width of the impressions from edge of inner toe to edge of outer toe of one and the same animal may differ some centimetres during the same walk; the great flexibility of these side hooves likewise emerges if the width at the top of the instep is compared with that at the base of the same footprint if the rhino has sunk 15-20 cm or even deeper into soft ground. In the first case the author measured differences of 2-3 cm, in the second of 3-5 cm, and once even of 7.5 cm! In addition the facts that there is an obvious though varying difference in size between the width of the fore and the hind foot, and that it sometimes happens that two prints largely or completely overlap and may appear to the observer as one print, call for the closest attention. When measuring the width of the large fore hoof, which of course is constant in the same animal and was almost always likewise measured by the present author, great attention must be paid—as in all other measurements—to the type of the soil, since this hoof leaves a full impression only on soft ground and merely a partial one on harder surfaces. Finally, the matter is complicated even further by the fact that there are various rhino whose foot width differs little if at all, at least does not find expression in the prints.

Schenkel (1969: 102) writes that animals could be distinguished by the difference in width between fore and hind foot, but from the above it is sufficiently clear that the width of such prints in the same rhino may differ to such an extent, even during the same walk, that distinction between animals can hardly be based on this.

Measuring the width of the sole leads to less satisfactory results than determining the measurements indicated above, since it is even more difficult to point to differences from rhino to rhino and the impression of the soles cannot even be accurately measured in many cases. The gait, which in such cases could indicate some difference, never offers anything to go on, since major differences may occur with one and the same animal, even during the same stroll (see also Chapter 12).

The tracks sometimes found near wallows may easily give rise to optimistic speculations, and that is even more strongly the case with the old dung heaps, of which one can sometimes find 30 or more on one single day. But if one then seriously investigates how many of these are not older than two or three days, and if one knows from experience how long such droppings often stay where they are, there is not the slightest reason for optimistic estimates of the number of individuals that deposited these faeces.

It will be evident from the above that taking an inventory of a local stock of rhino on the strength of the footprints measured is a highly skilled and complicated business. The inaccessibility of the area and the great variety of soil and vegetation within almost every square kilometre of the sanctuary also make it impossible to arrive at a satisfactory estimate of the total number of rhino living there by means of the tracks encountered in the part that is easily accessible to man, for

such an estimate must also include the barely passable sections of terrain, in which taking a satisfying inventory is often almost impossible.

The author's estimate of the number of *Rhinoceros sondaicus* living in Udjung Kulon in 1937-1957 is based on his surveys, in which attention was paid not only to the rhino observed, but equally to all the other details indicated above, especially to those which could easily lead to too optimistic a picture. The small number of fresh feeding marks, recently deposited faeces and wallows in use, added to the relatively rare encounters with the animals themselves and the scantiness of indications that a somewhat satisfactory number of young and semi-adult specimens were available, constantly worried the author. It is on the strength of a combination of all his experiences that he never estimated the number higher than 25-35 and that he puts it at 15-20 (in 1965), in contrast with the number of 47 (38-56) arrived at by Talbot in his 1964 report.

Partly in connection with Schenkel's estimate of 21-28 rhino in 1967, the author expresses his surprise that Verschuren (1967) writes on the strength of Talbot's estimate: "As indicated previously the number given by Dr. Lee Talbot must be very close to reality—perhaps a little too high", because Schenkel estimated the number at 21-28 barely 3 years after Talbot's estimate of 47. In Chapter 16 the present author will return to the subject.

CHAPTER 12

PHYSICAL AND SOME OTHER DETAILS

AGE

On this point the author can say nothing from his own experience. A specimen of *Rhinoceros sondaicus* lived for 14 years in the Calcutta Zoo, and according to Krumbiegel (1960) another rhino belonging to this species—incorrectly designated as *Rhinoceros unicornis*—lived for 30 years in the Adelaide Zoo, which of course means nothing with regard to the maximum age. It is almost certainly this animal of which Lord Medway (1969) writes: "The longevity record is held by a male which lived in the Zoological Gardens of Adelaide, Australia for approximately twenty-one years (1886-1907)". Purchased for £ 65 in Singapore in January 1886 by R. E. Minchen, director of the Zoo. The animal was about eighteen months old when purchased and was exhibited at the zoo as a Great Indian Rhino. Its true identity was not discovered until its remains were studied at an Adelaide museum". Cases are known of *Rhinoceros unicornis* living for 40-47 years in a zoo (Sody 1959: 210). Referring to some authors and on the strength of field observations—which, however, do not offer the slightest proof of so great an age—Gee (1953) is of the opinion that the latter species can reach just as advanced an age as an elephant, viz. an age of 70, while Ripley (1952)—though without adducing any proof either—states that an age of 50-60 years "would seem a reliable guess". However, Flower (1931), Acharya (1932) and U Tun Yin (1967) mention a longevity of 25-30, 22 and 22 years respectively.

There is much difference of opinion about the age at which rhino may be considered adult. According to Sody (1959: 198), P. Chalmers Mitschell (1912) suggested that this is the case after 7-8 years with regard to *Rhinoceros unicornis*, while Brehm (1891-1894) gives 13 years. Ripley (1952) writes with regard to this species: "As with the elephant, it could be presumed that a rhinoceros is adult by 12-15 years of age, although it may grow after that". From the experience gained in the Basle Zoo (Lang 1961) it has emerged that a young animal of *unicornis* aged 4 years and 7 months already gave birth to a normal, perfectly healthy calf after a gestation period of about 16 months. But it was also established there that a rhino cow regarded as adult in July 1952 increased in withers height from 152 to 160 cm in the period 1954-1960.

Schenkel (1969: 130) suggests that the cow of *sondaicus* should reach sexual maturity at the age of 3 years (as is the case in *Rhinoceros unicornis* in captivity) and that the bull should be sexually mature from 6 years on, but much research will be necessary to confirm such suggestions as far as *Rhinoceros sondaicus* is involved.

BODY SIZE AND WEIGHT

Drawing upon his personal experience on this subject too, the author can say extremely little since he has never encountered a measurable, dead rhino; estimates of height at the shoulders or the withers could be made only on observed specimens or by measuring pushing or feeding marks encountered on trees.

The specimen killed by Franck (1934), described by him as an old bull, had a shoulder height—measured on the cadaver—of 160 cm; however, Hazewinkel (1933) gave only 128 cm and 140 cm as the height at the withers for a bull of this species shot in Sumatra. Sody (1959: 117) rightly doubts these dimensions, although the lengths given by Hazewinkel, 315 and 305 cm, tally fairly well with those stated by Franck. D'Arcy Weatherbe (1939) states as shoulder height 5 ft. 6 in. (168 cm) "or even more" and Lord Medway (1969) 140-170 cm; according to Sody (1959: 117), Dollman even mentioned 178 cm for specimens from the Asian mainland. Sody also mentions 178 and 166 cm for other specimens from outside Java; on the strength of these dimensions he adduces the possibility that the species reaches a greater size on the continental mainland than in Java. According to the present author it is probable that rhino standing 170-175 cm at the shoulder also occur in Ujung Kulon, but perhaps only where females are concerned. It must have been such animals which left mud tracks at stable points (thick trees) at heights of 250-267 cm. This implies that with a head length of about 70 cm (Sody 1959: 116) and the always short neck, rhino reaching so high must stand more than 160 cm at the shoulder.

The author's supposition that the cow averages larger than the bull is based solely on the facts that the largest specimens which he saw were females and that his native trackers also shared this belief of old. It was likewise the conviction of the experienced rhino hunter A. R. W. Kerkhoven (Sody 1959: 116). Although Sody suggests that this opinion is not a generally current one and expresses the belief that Kerkhoven may have seen an adult cow in the company of a large calf, it may be said that there are more indications that females of the Javan species become larger than the bulls rather than vice versa, but the question remains open for discussion, since age differences may play an important part when considering weight and body size.

The figures published for *Rhinoceros unicornis* in the Basle Zoo indicate that an adult cow is considerably smaller than an adult bull; for these animals a shoulder height and weight of 160 cm and 1,608 kg and 178 cm and 2,070 kg respectively are mentioned (Lang 1961). From the measurements made in the zoo there it has also emerged that it probably takes some considerable time before the maximum shoulder height is reached (at least in the case of *Rhinoceros unicornis* in captivity), as was established by Lang (1961). Consequently Schenkel's statement (1969: 127) that in this zoo females of *Rhinoceros unicornis* reached full size after 2.5 to 3 years, when showing a fore foot width of 26 cm, cannot be correct. This is also in contradistinction with his own figures of a female in that zoo 10.5 years old, with a fore foot width of 27-28 cm. Since he thinks it "justified to correlate width of foot-

prints and age classes for the Javan rhino according to the time-table of the Indian rhino" the above statement is also contrary to the footprint measurements given by him for "largest females" in Ujung Kulon, viz. 29-30 cm, which fairly well agrees with the experiences of the present author.

Franck (1934) gives a lower figure for the height at the withers than at the shoulder, but in the experience of the present author this is not always the case, at least not with free-living wild specimens. It was also possible to establish the converse, together with a more or less equal height, as emerges from photographs taken by the author.

Franck gives 392 cm as the overall length of the bull shot at Tasikmalaja from the muzzle to the tip of the tail, and 320 cm as the "hunter's measure", i.e. measured straight "between pegs" (not along the curves of the body) from the muzzle to the root of the tail. This author also gives many other measurements.

As regards the weight, too, the author is only aware of what Franck (l.c.) states for the bull referred to above as shot by him, which he says weighed 2,280 kg, of which about 986 kg was quoted for the fresh skin. He gives 25-30 mm as the thickness of the skin of the neck shield.

From the details given above it may be derived that the maximum sizes given by Krumbiegel (1960), height 140 cm and length 300 cm, for *Rhinoceros sondaicus* are unacceptable.

As regards the weight and the height at the shoulder and withers given above, the impression is gained that there is only a minor difference in size between this species and *Rhinoceros unicornis*. For the male animal weighed in the Basle Zoo proved to be over 200 kg lighter than the above-mentioned bull killed in Java, the only one of which the weight was exactly established. The maximum shoulder height of *Rhinoceros sondaicus* of the Asian mainland is exactly the same as that given for the Basle bull of *Rhinoceros unicornis* (Lang 1961). This could also be derived from the measurements given by Gee (1953) for a very old bull of *Rhinoceros unicornis*—known as "Boorra Goonda"—found dead, viz. 175 cm as shoulder height and 327.6 cm as overall length without the tail (however, it is not said with regard to this last measurement whether it was made "between pegs" or over the curves of the body). According to the same source, a bull of the same species in the London Zoo in 1871 was described as being "of enormous size", since it stood 160 cm at the shoulder and had an overall length of 320 cm, which are exactly the same measurements as those established by Franck on *Rhinoceros sondaicus*. For the shoulder height of 6 ft. 4 in. (193 cm) given by Talbot (1960) for *Rhinoceros unicornis* no proof is adduced.

For sizes and weights of semi-adult specimens see Chapter 16.

THE HORN

For the length of the horn that adorns the front of the bull's head rather varying sizes are given in the literature, but in the author's opinion the maximum of 27 cm, measured along the greatest curve, given by Rowland Ward (Sody 1959: 117), comes very close to reality; however, this maximum has only most rarely been

established by the author. The specimen shot by Franck had a 21 cm horn; probably this is a good average. The length of 37 cm given by Hazewinkel (1933)—along the greatest curve even 48 cm!—is probably based on a mistake; if not, the horn in Sumatran specimens perhaps reaches a greater length than in those found in Java. The circumference of the base of the horn was stated by Franck to be 565 mm, and as a cross section he mentions 210 × 130 mm; Hazewinkel gives 220 × 150 mm.

As the reader will be aware, the female of *Rhinoceros sondaicus* does not possess this horn, but at the same place there is a hump which sometimes may be some centimetres high. The drawing of the Javan rhino reproduced by Sody (1959: 114) more closely resembles a bull, for the horn is much too small for that of an adult male.

The first who doubts the absence of a horn in the female of this rhino species is Schenkel (1969: 130): "Former authors have claimed that the female Javan rhino has no horn or only a small hump. Schuhmacher (1966) has photographed a Javan rhino which had no horn, but also the ears of this individual were rudimentary and it may not have been normal. All the rhinos which we ourselves have seen with the exception of the three immatures had a definite horn. Also all the rhinos which the guards reported to have seen in 1967 and 1968 had a horn. Clearly among all these individuals some were females."

This important statement asks for some comment. It is not quite in agreement with the facts to write that "former authors have claimed that the female Javan rhino has no horn", since the absence of a horn or the presence of only a hump in the cow of this species has been established many times on killed specimens. The head of a hornless female shot in 1914 by V. de Sturler was still in the Zoological Museum at Bogor when the author left Java (see also Sody 1941: 50-51). A drawing made after a photo picture of the head of such a female is published by Sody (1941: 66) and likewise a drawing of a killed hornless female shot by Andray (Sody 1941: 41); there is also a female shot by Vernay that must be present in the British Museum at London. According to the same author (Sody 1941: 9) Sclater recorded "a large stuffed female in the Calcutta Museum, which shows *no trace of a horn*." On 23 October 1969, Dr. A. W. Gentry of the British Museum of Natural History wrote the author that the four males available have horns, the two females do not. He considers two other males without a horn to be wrongly labelled. Dr. Gentry adds that there is no clear example of females with a horn and "that it is very likely that there is a good sex difference for this character." In his letter of 24 October 1969 Dr. R. G. van Gelder of the American Museum of Natural History, New York wrote that the only female of this rhino species present does not have a horn. Dr. D. A. Hooijer of the Leyden Museum of Natural History found that the skulls of the few cows available in that museum have only a suggestion of a small horn, much less pronounced than is the case in adult bulls.

Unfortunately most skulls examined by Groves (1967) were not sexed, but a sufficient number were to enable him to say with confidence "that marked size difference is found in only one feature—nasal breadth: a happy result, as it not only allows for larger samples, but it also reflects the different horn sizes in the

two sexes." In his letter of 27th November, 1969, Groves wrote to the present author that females are not invariably hornless and may have small horns. He added that the cow shot by Vernay in Perak had a rudimentary horn. He suggested that " (from a study of the growth of the nasal bones) the horn in the female ceases to grow at some time during the juvenile period—if a horn of reasonable size has begun to arise, or if it has not, then the adult female will resemble the juvenile in that."*)

The author himself had ample opportunity to confirm the fact that females of this rhino do not bear a horn or that they have only a hump not larger than some centimetres; this was also the case with the animals reported on pp. 99, 119 and 133 when rhino cows could be observed close by and during a considerable time. As is evident from Chapter 16 there are also numerous reports of hornless females by the guards: they differentiated between male and female rhino on account of the presence or absence of a horn. As to Schenkel's suggestion that the rhino cow in Ujung Kulon without a trace of a horn pictured by Schumacher, should be an abnormal individual of which also the ears were rudimentary, it may be pointed out that in Africa rhino with badly injured ears and even with ears bitten right off are not exactly rare (see also Chapter 13). Judging from the author's experiences there is nothing abnormal in this rhino cow.

Schenkel (1969: 126) states that the three immatures seen by him had no horn. There is no proof that he saw young ones below the age of one year; the only solitary one he saw may be estimated to have been at least two years old. Therefore Schenkel's immatures were probably females. According to Sody (1941: 11) the horn is already present in newly born calves, even in the foetus, as was shown to him in the zoological museum of Brussels. In Basle a female of *Rhinoceros unicornis* had a horn of approximately 5 cm at the age of one year (Lang 1961). A male calf in Ujung Kulon of about 11 months had a horn of approximately 5-7 cm (p. 140).

The said three immatures were in two cases accompanied by their mother, but Schenkel made no mention of the presence or absence of a horn in these adult females. The present author is of the opinion that adult cows of the Javan rhino differ from the bulls by the absence or small size of the horn. If Schenkel did not succeed in ascertaining the sex of the individuals he saw, they probably all were bulls, unless there is clear evidence that in some cases females were concerned which would then be the first certain proofs of *Rhinoceros sondaicus* cows bearing a horn of some considerable size.

* More recently Dr. C. P. Groves produced a graph from which the difference in nasal breadth between animals of both sexes is very clear, showing hardly any overlapping. However, he examined a young female of this rhino species in the British Museum, shot in 1920 by T. R. Hubback in Tenasserim (Burma) of which it is said that it had a horn of 192 mm. Because this horn was removed and the animal was shown to the public without a horn, the present author does not consider this specimen the right material to prove the reverse of his opinion.

Most probably this is the same rhino as mentioned in D'Arcy Weatherbe's memorandum (1939) in which it is emphasized that "females sometimes carry a horny nasal protuberance". At my request Mr. U Tun Yin of Rangoon further investigated the matter and with the assistance of Mr. H. C. Smith and Mr. B. E. Smythies, who both worked in Burma for many years, it could be ascertained that the rhino cow shot by Vernay in Malaya in January 1932 has a very slight horn and that the one obtained by Hubback in Tenasserim in 1920 shows no trace of a horn! It is therefore Mr. Smith's opinion that the horn of a female of *Rhinoceros sondaicus* is either very small or totally lacking, which fully agrees with the present author's view.

As already stated above, the horn consists of a mass of hair grown together which develops loose from the skull and is said already to be present in the first instance on new-born calves (Sody 1959: 119). The further development probably goes very quickly; from the particulars given above it emerges that a female *Rhinoceros unicornis* in captivity already had a horn of approx. 50 mm at the age of a year.

Gee (1964) says of the horn: "Rhino horn consists of compressed or agglutinated 'hair'; or, more scientifically, keratin fibres cemented together in a hard compact mass. It is not fixed to the skull but is epidermal and rests in the flesh and can be knocked off by a hard blow. When a rhino's horn is thus struck off, the wound bleeds profusely but within a year a new horn will start to grow there".

The author has made no notes on the colour of the horn. Probably this does not differ strikingly from that of the skin; like the latter, the horn is often soiled or discoloured by mud. Sody (1959: 120) puts forward the possibility that the colour varies according to the age of the bearer. This author also reports that on a number of occasions a *Rhinoceros unicornis* that had lost its horn in captivity through an accident grew another one, though not to the original length. On a female specimen of this species in the Basle Zoo a growth of 25 mm was noted within two years (Lang 1961). Doubtless the horn of the Javan rhino is subject to fairly considerable wear owing to its intensive use in clearing obstacles in the dense vegetation in which this species usually prefers to live.

SENSES, INTELLIGENCE, PHYSICAL CAPACITIES AND SOUND

Senses and intelligence

Of the senses, those of smell and hearing are doubtless the best developed; the animal may put more trust in its hearing, which does useful service irrespective of the direction of the wind, than its power of smell. Its sight is definitely poor. But the author considers it out of the question that its eyesight is as bad as Talbot (1960) tries to show with his statement that a rhino did not recognize him as a man at a distance of some five yards.

When observing rhino at night it was possible to see the "lightening up" of the animal's eyes when they came within the beam of a flashlight from which it is evident that the rhino is not solely a diurnal animal.

Gee (1964) writes of *Rhinoceros unicornis*: "Some people say it is slow of hearing and short-sighted, but I am not so sure of this".

Presumably its intelligence is also poorly developed, which probably leads in the first place to its endangering itself so often, among other things by approaching more closely to the arch-enemy of every large mammal, man, than any other wild animal the present author has ever known.

Physical capacities

Since the author has never observed a Javan rhino on a large open plain, it is impossible for him to express an opinion about the speed with which the animal can move under such circumstances. He considers it not very probable that in

that case it would be capable of reaching as great a speed as a normal sprinting man. But its speed in dense scrub wildernesses and muddy terrain is relatively high and also the manoeuvrability displayed in such surroundings is strikingly great. According to other observers, rhino can climb steep slopes in mountainous terrain with astonishing ease, which sounds very credible to the author in view of the facility with which the animals in Ujung Kulon climbed steep and muddy river banks and moved about highly accidented terrain.

Gee (1964) writes with respect to *Rhinoceros unicornis*: "It can easily outstrip an elephant, and can gallop, jump, twist and turn quickly, none of which things an elephant can do".

The author is not aware from his own experience what the maximum distance is that these pachyderms can cover per day; the extremely impassable terrain in which every rhino in Ujung Kulon spends the greater part of its existence makes observations on this point practically impossible. In the many cases in which the tracks were followed the animals disappeared after a short or somewhat longer time into parts of the terrain which were passable by man only with the greatest difficulty, and within which it is often impossible to make more than a few hundred metres' progress per hour. Along the south coast beach it could be established that rhino had set foot on the beach at a certain place via the low dunes, and had disappeared into the interior again 5-7 km further on, without trace being found of the animals having rested or even having stood still; such a walk is quite a normal occurrence. Elsewhere tracks were followed which pointed to nightly movements over at least these distances. The author is convinced that rhino travel not infrequently 15 to 20 km within one single day, but often also hardly leave an area of less than half a square km for several days; if they do leave it, they return at regular intervals.

The last point also emerges from the observations of the rhino cow with calf seen near the Karang Randjang guard bivouac (Chapter 16). These animals were observed there 18 times in the period from September 1954 to January 1956, but they were not seen at all between February and July and in September 1955; they were also tracked at distances of 15-18 km away from this bivouac.

As far as the author could establish, there are no natural barriers limiting the rhino's activities, except certain *Pandanus* complexes and extensive parts of the tidal forests.

Probably rivers which cannot be waded are swum, although the author never established this with certainty, since there are extremely few such rivers in Ujung Kulon.

Sound

From what Sody (1959: 123-124) says it emerges with sufficient clarity that the published records relating to the sound produced by our species of rhino vary considerably. It is not improbable that all the accounts cited are correct, with the exception of that by S. Müller when he disputes Lamare Picquot and regards the

roar ringing far and wide reported by the latter as a fable. In Chapter 16 the author describes the circumstances under which such very impressive roaring of *Rhinoceros sondaicus* was heard. It may therefore certainly be considered possible that what Lamare Picquot wrote: "Ein Geheul wie das eines wüthenden Stieres durchdröhnte den ganzen Wald" (with reference to a mortally wounded rhino cow), was quite correct. Gee (1953) cites a similar account of *Rhinoceros unicornis* by a well-known British rhino hunter, who wrote: "...it makes such a noise it can be heard a long way off. The noise once heard can never be forgotten". This case, too, related to an animal wounded by the hunter.

The present author once described the call heard on a few occasions, presumably caused by fighting rhino, as a frightful roar, resembling the trumpeting of an elephant or the furious low of a banteng bull. Besides this loud howling a hoarse sound was also heard, which perhaps was emitted by the cow. A second time—15 years later—the author described such calling as an enormous roar, like the trumpeting of an elephant, difficult to describe, but somewhat like a terrible and ominous "woo-woo" and later "wook". A second, softer, sound also heard was reproduced as "oowauh" and was compared to the bellow of a buffalo; however, it was also audible over a distance of a few hundred metres. Later the loud, puffing "woo-woo" was again produced, followed by a "foo-foo" that also could be heard far away. Then silence fell for a considerable time, followed again by loud puffing and a very frightening roar. In the still of the night this roar could be heard at distances of 800-1,500 metres away, perhaps considerably farther, which is proof enough of the volume (see also p. 132).

Hazewinkel (1933) mentions a low growl, changing into a savage sniffing and snorting, and finally ending in a short, intermittent bark, like that of an angry Malay bear.

Besides the roar described above, which puts that of a banteng bull and a tiger in the shade, other, less impressive sounds are produced now and then. These may normally be described as loud sniffing, snorting or puffing; without exception they have an unpleasant note to them and can often be heard over several hundred metres. Less loud sounds were heard from wallowing rhino, among others, comparable to the soft "engguh" or "eēh" cry of a buffalo, and also other similar soft sounds, together with those caused by respiration.

The sniffing was repeatedly noted as a loud "voo-voo" repeated several times; during an attack at night a loud snorting was heard, like "proose-proose", "hoocy-hoocy" or "shoo-shoo", very loud and threatening. In this case, too, the accompanying female emitted "mooing buffalo-like calls". During the daytime a charging rhino produced a "high-pitched sound" and a short "shof-shof", likewise audible over a considerable distance. In another case the loud sniffing of a charging bull was reproduced in the author's notes as an unnerving "hoosh-hoosh-hoosh". A rhino bull lying in a river was noted to emit a "high whistle", something like "poweet-poweet"; another rhino in similar circumstances was noted as uttering a "soft hiss", after which the animal rushed up the bank puffing and snorting. Because a whistling ("pfeifend") sound is also stated as originating



The south coast east of the Tjibunar

from a female *Rhinoceros unicornis* living in captivity while on heat, the author would like to stress that in the above cases it was uttered by a bull. "A whistling like sound" is also mentioned by Gee (1953) for the latter species in nature during the mating season, "probably made by the female". Perhaps also on the strength of Gee's experience Ripley writes (1952): "the so-called mating call is a sweet high whistle, very penetrating and presumably capable of being heard for a long distance by another rhino".

Later (1964) Gee, writing about the same species, says: "I have heard 5 different noises: A roar or bellow when newly captured, a snort when excited or disturbed, a grunt when not disturbed and a peculiar whistling sound at the time of courting and mating". According to Schenkel (1969: 121) "the whistle might function as a rather far reaching signal between loosely associated individuals." By the way, this loud blowing was the only sound Schenkel heard at three different occasions.

Two unalarmed rhino—in many of the cases mentioned above the animals could be described as alarmed—were once heard to utter a cry that might be compared to the barking of muntjac, but much louder. The late D. A. Faber, immediately after an encounter with a rhino bull in the middle of a river, described the sound made by the animal as "grunting like a wild boar". In addition chewing sometimes can also be heard dozens of metres away.

It will be clear from the above that *Rhinoceros sondaicus* has a much wider repertoire than the scanty literature data suggest. The author must, however, apologize for the fact that he is not capable of reproducing this more clearly than has been done above.

Generally speaking, however, *Rhinoceros sondaicus* can certainly not be described as a tumultuous creature, since it usually moves noiselessly through the jungle.

SNORTING MARKS

As far as is known, A. R. W. Kerkhoven is the only observer to have drawn attention to the spreading of saliva by snorting. According to Sody (1959: 215), this hunter wrote: "Sometimes the rhinoceros blows a curious liquid out of its nostrils. At first this liquid is clear, with a somewhat reddish tint, just like water with a very small quantity of wine in it. However, it very soon becomes turbid and a dirty orange in colour, and it then resembles the saliva of natives when they have been chewing betel nut. From the change in colour the native hunters can tell how long ago it is since the animal has used this trail." This is precisely the opinion of the present author too, but he is unaware of the meaning of this phenomenon. Although it was only observed eleven times in all, there is a considerable chance that it happens much more frequently, since the traces of saliva, which are usually only small, easily remain unobserved once they have lost their penetrating odour, which is the case after they dry out. In a fresh state, these marks may already be observed at a distance of 10-15 metres, since they have approximately the same penetrating odour as dung and urine. Originally this slimy saliva is presumably clear. Perhaps after a few hours or still quicker it passes

via wine red and dark red to dirty brown. Plate 34 shows a number of leaves of *Ardisia humilis* with such snorting marks; such spots of saliva are in general fairly evenly distributed over the vicinity of where the rhino was standing, sometimes up to a height of 150-250 cm; in those cases the animal had been standing with head raised. Once—on 29 November, 1950—large pieces of moist slime, which had remained completely white, were found on the ground beside the red specks of saliva; perhaps the former had dripped out of the mouth and had not come from the nostrils. Only twice was it established that such saliva came from a snorting rhino startled by the author shortly beforehand, but the animals were never caught in the act. The phenomenon was observed in March, August, October, November and December, and, in the few cases that the origin could be established, was produced by the bull.

The author considers it out of the question that these snorting marks have anything to do with the phenomenon mentioned below of the emission of large quantities of urine in the period during which the *Rhinoceros unicornis* cow is in heat, for both substances differ quite clearly from one another and could be easily recognized by the author. However, it is not out of the question that the large pieces of moist slime encountered in November 1950 came from the vulva of a rhino cow in oestrus, as was also found in the case of the rhino in Basle.

Schenkel (1967) believes that in cases as mentioned here urine is concerned; he writes: "...the bull squirts its urine in a shower onto the vegetation. The urine droplets have at first an orange, later a redbrown colour and a very strong smell even for a human nose".

As will appear below, this way of urinating was also observed with other species of rhino, among others with *Rhinoceros unicornis* in captivity; in these cases it is *not* stated that the droplets found in the vicinity were of an orange or redbrown colour. The small quantity of droplets encountered by the author in all such cases and the fact that they were sometimes found shortly after the snorting of the rhino had been heard indicate that this is *not* urine which, as emerged above, was also the opinion of A. R. W. Kerkhoven. In answer to the author's inquiry for information from the Basle Zoo, Dr. H. Wackernagel (in litt.) writes with regard to the *Rhinoceros unicornis* living there: "I have discussed your letter with Dr. Lang and our rhino keeper. We have not observed any different kinds of urine in our animals. The droplets, as well as the strong smell you speak of, are unknown to us".

This experience with *Rhinoceros unicornis* does not support Schenkel's statement that in cases as mentioned above urine is concerned. Later Schenkel (1969: 117) comments that for the Javan species it was assumed that the red liquid found on the leaves was blood from the rhino's nose, but that he never found a trace of blood and that the smell of urine was quite obvious. The present author knows no reports on blood from the rhino's nose. The slimy liquid was found to be pure white when fresh, not like blood; as to the smell it may be assumed that under certain circumstances the animal's saliva has the penetrating odour as found by the present author.

From Schenkel's statements it is also not evident that the urine is squirted so high onto the vegetation as the present author found the snorting marks.

FOOTPRINTS AND GAIT

Footprints

The measuring of the prints (Plates 30-32) was done very critically, and in general only those measurements were used which were imprinted in a soil in which the animals had not sunk deeper than 2-5 cm. As all rhino living in Ujung Kulon periodically visit the Zuiderstrand (beach along the south coast), which nowhere is much more than about 20 km away from any point in the sanctuary, and in most cases is much closer, considerable attention was paid to that beach in particular; on the hard sand prints could be measured most accurately and ebb and flood were of great assistance in determining the time at which these prints were made.

It goes without saying that the width of the rhino's foot is most closely bound up with the animal's age and, as a consequence, its size. In the present study, rhino showing a width of the fore foot (measured from edge of outer toe to edge of inner toe) exceeding 25 cm are considered as adults.

The statement of Lord Medway (1969): "The footprints of mature adults exceed 22 cm in average diameter" is somewhat confusing because in immature individuals of approximately a year, the footprints may exceed this width (see also Chapter 16).

The greatest width of the nail of the front toe (called the "fore hoof" below) was also measured. The average of 231 prints of the fore foot in adult animals was 28.05 cm; that of 118 prints of the rear foot was 26.10 cm; that of 161 fore hooves was 11.77 cm and that of 68 hind hooves 11.04 cm; this clearly illustrates the difference between the two feet. In a very few cases the author could not demonstrate this difference; for instance, on 6 October, 1942, he measured a clear spoor which was noted as 28.5 and 4 × 27.5 cm for the rear right foot and as 2 × 27 and 2 × 27.5 cm for the front right foot. This difference was probably caused by the side-toes of the fore foot not being spread in the normal way, which might have been the result of a defect.

Schenkel (1969: 119) published a drawing of the footprints of a Javan rhino in which the front hoof of the fore foot (19 mm) is smaller than that of the rear foot (21 mm); actually in all animals the fore hoof is larger than the hoof of the hind foot.

As is evident from the table published on p. 127, most spoor showed a fore foot print from 27 to 29.5 cm inclusive and a print of the hind foot from 24.5 to 28.5 cm inclusive, whereas most prints of the large front hoof varied from 11 to 12 cm. The largest footprint measured was 32 cm wide and the maximum width of the fore hoof amounted to 15 cm, established in a very few cases only. However, measurements of 30 cm and of footmarks still exceeding this width and of a fore hoof width of 15 cm and more may perhaps be exaggerated somewhat; on hard ground

such maxima will without doubt be very rare. In Chapter 11 it was already pointed out that a number of factors, especially those connected with the type of soil, can seriously influence the results of the measuring discussed here. True, in evaluating the figures an attempt was made to take the type of soil into account, but this did not always prove successful.

In fixing the above-mentioned averages no difference has been made between both sexes because in too many cases the presumed sexual dimorphism in the footmarks could not be established. The author learned how to distinguish such differences from a number of trackers (poachers of the old days) well acquainted with these animals; during the author's first visit to the sanctuary it already became evident that these people were able to state the sex directly from clear tracks, which it was possible to confirm in a number of cases in which further tracking had positive results and the animals were met with. Sexual dimorphism is supposed to be present in the hoof of the middle toe (the fore hoof) which in the bull is curved inward to a larger extent than is the case in the cow; this is often fairly clear to see, sometimes even on an imperfect print. However, the question remains open for serious investigations because there is a possibility that this character is an individual one connected with age, irrespective of sex.

The print of the rear foot is usually some centimetres behind that of the front foot of the same side, but in the course of one and the same walk this distance may differ from 10-20 cm and even more. Often, too, the fore print is partly overlapped by that of the hind foot (Plates 30, 32), although it is comparatively rare for the two prints to cover one another entirely or almost entirely (Plate 32).

Even in a superficial inspection it is easy to distinguish the footmarks of the two flanks from one another; the two feet on each side make a clearly different spoor, although the distance between the right and the left inner toe is often only 10-15 cm or less, from which it is clear that the feet are placed very much inwards (Plate 30).

In the case of the footprints indicated above and the stride to be discussed below, it may be pointed out that the partly overlapping imprints of the front and rear foot in many cases makes it impossible to measure a "clear" print. But usually one can speak of confusing footmarks only if both prints overlap almost completely or if the hind print lies obliquely across the fore print, thus making it impossible accurately to determine the width of a single print. In addition measuring is sometimes hampered by the rear foot being dragged right across the spoor of the front foot. By considering all these factors an effort was made to render the figures collected as reliable as possible.

In Schenkel's drawing mentioned above the print of the rear foot lies in front of that of the fore foot and both prints overlap almost completely. Accordingly he states that the hind foot is put almost on top of the front leg's pugmarks. As far as can be derived from his fieldnotes, the present author only very rarely found the print of the rear foot in front of that of the fore foot; this seems logical because it requires a suppleness the average rhino does not possess. Entirely overlapping

footprints were also found much less frequent than slightly overlapping or separate ones. The present author also disagrees with Schenkel's statement (1969: 102): "The prints of one foot could show variations of 1-1.5 cm according to speed of pace, gradient of terrain and type of soil." In Chapter 11 it is pointed out that the author found such differences to vary from 2 to 5 cm.

As the measured footmarks naturally indicate the width of the foot as the weight of the rhino presses on them, in the course of which the side-toes are spread, it will be clear that the figures obtained in this way differ from the results obtained when measuring dead animals, in which the toes are not spread, or are spread artificially. For this reason figures obtained by these two methods are not suitable for comparison.

At the author's request in 1966 Dr. H. Wackernagel of the Basle Zoo measured the tracks of *Rhinoceros unicornis*. On a female 19 years old a front foot width of 26-27 cm was established, and a rear print of 23.5-24.5 cm, beside a fore hoof width of 13-14 cm and 9-12 cm respectively. For an eight-year-old bull these dimensions were 28-29 cm; 26-28 cm and 14-15 cm and 12-14 cm respectively. Later some of these figures were also quoted by Schenkel (1969: 127).

It may be derived from these data that in size the average footmark presumably does not differ much from that of *Rhinoceros sondaicus*; a difference in soil in which the feet were impressed may suggest a narrower footprint of the Basle animals. However, the width of the fore hoof of *Rhinoceros unicornis* seems to be definitely larger on average. These figures also indicate that in the case of the latter species the bull is larger than the cow and not vice versa, as the author believed that he had established with regard to *Rhinoceros sondaicus*.

Milton (1963) measured the following print width on three presumably different individuals of *Dicororhinus sumatrensis*: 14, 18.5, 19 and 22 cm, and a fore hoof width of 5, 6 and 8 cm, which clearly illustrates the much smaller size of this species. Strickland (1967) too mentions for the footprint of an apparently old bull 21-23 cm, also clearly pointing to a much smaller size when compared with *R. sondaicus*. He also found a difference of only almost 2 cm between the tracks of the same animal left in soft mud and those left in hard sand, which likewise indicates a considerably smaller weight than the Javanese species.

A photograph made by Milton of a plaster cast of a print of *Dicororhinus sumatrensis* differs considerably from the photographs which the author took of such prints of the Javan rhino. For this reason the author cannot agree with Guggisberg (1966) when he writes: "but except for size, the tracks are almost identical" and "in areas where formerly both species existed, it was very difficult, if not impossible, to distinguish them by their spoor". On the contrary, it must be very easy to distinguish these two species by their footprints.

Little has been published on the presence of foot glands in rhino, but Prater (1939) writes: "Further, both *unicornis* and *sondaicus* have so called "foot glands" embedded in the integument of the foot; in *sumatrensis* these glands are absent."

but of possible differences of trackmark in different types of soil and in different types of terrain.

Gait

In this monograph the gait or stride is taken to be the distance between the successive imprints of the front foot on the same side, measured between the points where the fore hoof first touched the ground. In about 160 measurements of the front legs relating to individuals moving over largish stretches this distance varied from 124 cm (only measured once; in addition, strides of up to 150 cm were only established seven times) to 220 cm in animals regarded as adult, but in the majority of cases from somewhat above 150 to 180 cm. In the case of the same rhino maximum differences in the distance between two successive imprints of the same fore hoof of 125-220, 158-220, 139-184, 124-168 and 144-184 cm, i.e. displaying differences of 40 to 95 cm, were measured during the same walk, sometimes over distances not exceeding some hundred metres of the route covered. Non-adult specimens can be identified not only by the smaller width of the foot but also by their smaller gaits (100-130 cm). There is doubtless a connection between the stride and the type of the soil the rhino is walking upon, but more characteristic is the speed of the animal; in contrast with what might be expected, very long gaits were occasionally measured in loose sand or soft mud, in which the animals had sometimes sunk 20-30 cm. A stride of 189 cm was established on a rhino that had sank 27 cm in loose sand; but against this is the fact that very small steps were likewise noted in mud 40-60 cm deep. It goes almost without saying that rhino walking slowly, as was often observed in the vicinity of wallows or during browsing, often take very small steps which are hardly worth measuring; they have consequently not been taken into account above.

If it is desired to interpret the stride as the distance in length between the prints of the fore hooves of the two front legs, the figures given above will have to be about halved. Perhaps this was done by Franck (1935), for he wrote: "At walking pace an adult badak bull may have a stride of one metre", because only very slowly moving rhino will produce such small gaits when measured in the way the present author did.

The author considered it useful to give all these details on footmarks and gait for comparison with data which might be collected on other Asian rhino. Besides, they are very important for inventory purposes, since we have to do with an animal which is so difficult to set eyes on.

REACH

In the case of 44 pushing, rubbing or browsing marks measured by the author higher than 130 cm, which marks could have not been influenced by any other cause, 26 were at a height of 200-267 cm among which 10 above 220 cm, viz. at 222, 222, 230, 247, 250, 250, 256, 260, 260 and 267 cm. This highest mark consisted of mud rubbed off by a rhino on to a tree; pushing marks made in the course of attempts to overturn trees were found at 250 and 256 cm; other mud marks were at 247 cm, 230 cm (twice) and 222 cm (twice). The highest browsing marks were

measured at 250 cm (twice) and 260 cm (twice). In cases where marks were found at 250 cm and exceeding this height, they must have been made by exceptionally large animals, since no signs were found that the rhino had stood with their fore feet against the trunk or had been able to reach higher in some other way than was possible from the ground. As stated on p. 107, the maximum height at which rubbing marks were found almost exactly agrees with the one at which feeding marks were established.

LAIRS OR RESTING PLACES

Sody (1959: 134) repeats an account given by Kühl and Van Hasselt in the *Algemeene Kunst- en Letterbode* of 1822 on the finding of many lairs of rhino in the higher areas of Mt. Pangerango above Bogor. The present author never found lairs in Udjung Kulon; except in the wallows, he came across extremely few certain traces of resting rhino. Such traces were noted only ten times, viz. in January (1), March (3), August (1), October (1), November (3) and December (1), including four times along the beach. Occasionally, resting animals were startled during the daytime, but usually evidence could be obtained by the mosaic pattern of the hide impressed on the ground; the latter may, of course, easily be overlooked. It is practically impossible, based on the spoor, to recognize animals which rest standing because rhino on the alert may stand motionless for quite a considerable time. *Rhinoceros unicornis* in captivity was often observed (Lang 1961) to lie for long periods on the ground both by night and by day and to sleep or slumber in that position.

Schenkel (1967) writes: "younger animals lie down, older ones stay motionless in the cover of dense vegetation", but it is the question whether such a statement is justifiable on the strength of the few rhino *seen* by him. He further (1969: 118) reports that on five different occasions animals were found between 10 a.m. and 2 p.m. while resting and sleeping in a wallow or river.

The author is not of the opinion that *Rhinoceros sondaicus* in Udjung Kulon has fixed resting places which are often frequented and which might be called "lair".

FAECES

General

This subject has already been reported on in detail in Dutch on an earlier occasion (Hoogerwerf 1952⁹). Partly in connection with later experience, the data are given here again.

There is scarcely a place in Udjung Kulon where rhino dung could not be found; however, the author never encountered it on the extensive coral reefs along the coast, a milieu which rhino definitely dislike. Probably they prefer open places or spots where the vegetation is thin or the ground is bare, although faeces were also seen in the densest scrub jungle and understorey. Most dung was found along or by the beach (Plates 38-40) which, however, may be caused in the first place

because they are most conspicuous there. A preference of rhino to deposit their dung on ridges or hills was established by Schenkel (1969: 116).

The droppings of a rhino are intermediate in shape to those of a horse and an elephant; the smell somewhat resembles that of fresh horse manure (Plate 37).

The size of the dung heaps varies greatly. The 12 largest specimens measured varied from 50-90 cm long to 30-75 cm wide with a height of 14-30 cm; the largest dung pile ever seen by the author measured 90 by 75 cm and was 24 cm high. These are measurements of dung heaps of which it was certain that they had been produced by only one rhino at a given moment.

The number of balls of dung, which usually resemble fragments of a big sausage, varied from 3 to 24, but piles consisting of 15 to 20 of such segments were the most numerous. In diameter a large number of such balls varied from 8-20 cm (8-10 cm was a great exception) with 12-16 cm as the most common diameter; on only eight occasions was a cross section of 18 cm measured, three times one of 19 cm and on two other occasions one of 20 cm. In one and the same dung heap differences in diameter were found of 8-15, 9-16 and 14-20 cm, which shows that one must be careful when determining the identity of an individual rhino on the basis of its faeces, as far as the size of its dung balls is concerned. From these figures it is evident that a ball with a diameter of 7 cm needs not to come from an immature animal, as Schenkel (1969: 115) states.

The weight noted for a number of dung heaps was 22, 18, 16 and 15 kg; in addition a heap consisting of only three balls of dung had a weight of 4.5 kg. A ball of dung measuring 19 × 12.5 cm weighed 1 kg, whilst another of 18 × 17 cm weighed 1.25 kg. Lang (1961) gives as total weight of two piles deposited during the same night by a bull of *Rhinoceros unicornis* (in captivity) 45 kg, and for the weight of a single heap produced by the cow 32 kg. This cow defecated twice in the daytime and once at night during the same day; the bull defecated four times during the daytime and twice at night. The author knows nothing about the frequency with which *Rhinoceros sondaicus* defecates.

The droppings consist of a large number of indigestible, largely coarse fragments of plants. Plate 41 shows this and in addition the fragments of twigs stripped of their bark which are encountered in large numbers in all the droppings, besides indigestible remnants of leaves (of *Viscum* sp., *Corypha utan*, *Pandanus* sp., *Mimuseps elengi*, etc.) and sometimes also fruits or parts of them (such as *Arenga pinnata*). See also Chapter 14.

Franck's statements (1935) on the droppings of this species of rhino are largely incorrect, for its faeces never have what he calls a "cake shape", while such a dung heap is often much larger than twice that of a banteng (a dung heap of a large banteng bull weighed only 6 kg); and also the size of the dung balls, for which Franck states a diameter of 7.5-13 cm and which Appelman (Appelman & Franck 1934) compares in size with a tennis ball (about 6.5 cm), is not given correctly by these authors.

The piling up of faeces

Although the dung heaps are probably deposited in solitary fashion as a rule, it is quite common to come across various heaps in the immediate vicinity of one another in Ujung Kulon (Plate 40). Although for Java in general Junghuhn spoke of "paths which in the literal sense of the word are blocked by the tremendous quantity of rhinoceros dung", and also mentioned "dung heaps of these animals, small mounds two feet high, which we had to clamber over" and, according to Sody (1959: 139, 160), another observer speaks of "large heaps of faeces which it is practically impossible to pole-vault over", the author never encountered such a situation, which perhaps is another proof of the animal's present scarcity in this reserve.

Ripley (1952) reports something similar with regard to the dung of *Rhinoceros unicornis*: "These piles or mounds are usually in the center of a cleared area, and may be several feet high, perhaps three in the center, spreading outwards to a radius of four or five feet". And he goes on: "...and the hill is created by the rhino's habit of slowly backing up to the mound in order to defecate".

Though the author sometimes found two to five or still more heaps close together, they were almost without exception separate, and most rarely deposited on top of one another; even in the latter case a greater height than 30 cm was never measured. Once seven dung heaps were found in an area measuring only 5 by 2 m; once four within 6 square metres; four times nine of them within an area varying from 25 to 54 sq. m; once 14 within 7 by 11 m; once 15 heaps within 10 by 10 m, and as a maximum 17 on an area of 20 × 3 m. It also happened that the droppings were somewhat further apart: three heaps at 5, four at 20 and seven at 9 running metres. Solitary dung heaps were encountered more frequently: 12 and 15 spread over 3-5 km; along the south coast beach 20 heaps were once encountered over a distance of 2.5 km. On another occasion 25-30 dung heaps lay over a distance of about 9 km, and once 46 were found along a jungle trail about 4 km long; the discovery of about 45 heaps of faeces over a distance of 15 km—likewise along the south coast—was no everyday occurrence either. The record was formed by 80 such heaps which were counted on 25 November, 1955, along that beach over a distance of about 18 km. However, there is no consistency; on a jungle trail where on one occasion 15 dung heaps were counted over some kilometres, there was not one to be found during a later visit. Such was also the regular experience elsewhere, which may indicate that this species is not tied to a certain place in Ujung Kulon.

However, any indication with regard to the number of different rhino that recently visited such places can be obtained only by means of *fresh* dung heaps; these were sometimes entirely absent and in other cases scarce, but never numerous. In the cases cited above this number was never higher than four or five, divided among the last two to four days.

Schenkel (1967) much more often found series of dung heaps of different age than solitary ones. Droppings lying alone, which of course also remain visible for a shorter time, are less striking and may well have led to this conclusion; the great

difference in duration of observation in both these cases also makes comparisons difficult.

Especially during a dry north-east monsoon or another lengthy period of drought the dung lies there for several months, sometimes six or more, so that in actual fact even one single rhino would have had time to produce such quantities of dung as sometimes found by the present author. In general droppings lying outside the beaches disappear more quickly than those deposited on the high beach, for in the first case the heaps are often scratched apart by peacocks or junglefowl (which rarely forage on the beach) and occasionally rooted up by wild boar, after which they are quickly overgrown by vegetation; so far as could be established, dung-beetles and their larvae do not obviously contribute to this job. During periods of heavy downpours the faeces disappear rather quickly, sometimes improbably quickly, from the beaches too. Of the 17 dung heaps found together on 25 November, 1954, on a small meadow covered with short grass along the south coast, only one was found again on 24 February, 1955; the others had as good as vanished. After heavy showers of rain fresh faeces create the impression of being of much older date and are soon no longer recognizable as a dung heap. On the beaches the dung disappears in the dry season almost exclusively as a result of the high tide or is covered by sand as a result of long-lasting high winds, which are a common occurrence.

According to the present author, the dung heaps lying together cannot be accorded that special meaning suggested by certain authors, although perhaps some significance as a medium of interspecific communication may exist. Sody (1959: 205-208) puts forward the possibility that rhino have fixed resting places and defecate in the vicinity of these; and Ripley (1952) supposes that "... these dung-hills are territorial markers and that during part of the year each individual male or female rhino is king or queen of his or her own dung heap".

Thom's assumption (Sody 1959: 207) with regard to *Dicerorhinus sumatrensis* is perhaps correct when he writes: "The odour of the droppings, even though not their own, seems to attract the animal's attention and causes it to halt and evacuate at the same spot" (see also Hoogerwerf 1952^b). Although the author has earlier voiced the supposition that these heaps were presumably deposited by one and the same animal, later observations of spoor changed his mind; he now shares the opinion on this point of Gee (1953) regarding *Rhinoceros unicornis*, which is more or less a confirmation of Bengt Berg's experiences (1933), amounting to the fact that the penetrating odour of the dung stimulates every rhino coming in the vicinity to defecate. Probably such a stimulus is no longer present if the droppings have lost their original composition and odour.

It is a regular occurrence that in the wide vicinity of such concentrations of old dung no fresh rhino faeces can be found; this proves that the territory changes. Gee writes about this: "It is my personal belief that, although rhino generally remain in one particular part of the sanctuary, they move about freely within that locality according to availability of grazing, mud wallows, water, crops to raid and so on. I believe that dung heaps are used by any rhino which happens to be passing

by, after the fashion of dogs at lampposts". He also cites an instance in which a rhino, upon sighting a dung heap, left its path, walked over to the heap and defecated, and mentions another case in which a passing specimen walked to such a heap and tried to defecate "without much result". In accordance with Ripley (1.c.) he writes elsewhere (Gee 1964) that the rhino usually finally approaches such concentrations of dung backwards.

It is the author's opinion that in Ujung Kulon, too, every rhino has in general a preference for a certain part of the reserve. And yet it may happen that such an area is not visited for a long time, in which case the animal may be encountered anywhere; proof of this is the absence of large concentrations of faeces at places where these formerly lay. The relatively few times that such accumulations of droppings were seen, together with the inconsistency in locality and time at which they were deposited, suggest varying territories of this often nomadic species. Concentrations of dung as described above, and more considerable ones, ought most probably to be much more common if Ripley's opinion (1952) were correct and if they formed markers of a territory for rhino not in rut.

The important hypotheses voiced by Ripley with regard to the significance of these dung heaps and to the abandonment during the rutting season of the territory which he believes these concentrations of dung demarcate are insufficiently motivated and not supported by observations in the field.

Burying the faeces

According to Sody (1959: 208), various authors mention the African *Diceros bicornis* kicking its droppings to pieces. It is possible that this is likewise done by specimens of the Javan species, but the author was unable to confirm this. It may, however, be said that rhino had partly buried their faeces or had attempted to do so. Sometimes it appeared as if they had scraped a hole, as some other animal species are known to do, before they defecated. The burying of faeces or attempts to do so were noted on 15 occasions by the present author, almost without exception on or near the beach. In five cases it was fairly certain that the rhino had scraped out holes of 55 × 60 and 40 × 50 cm and 15-20 cm deep, after which the faeces were partly covered with sand. This was done with the hind legs, as could clearly be seen from the scratching marks, without the dung being entirely concealed from view (Plates 38, 39). Only rarely were the droppings partly kicked to pieces by these actions. Once a rhino had tried in vain on close turf to cover a dung heap; another time this had been only partially successful on very hard ground. In both cases the animal had scraped the ground at least with the fore hoof of its hind legs.

The author considers it probable that the manipulations described above are definitely not the rule and that they were confined to only a few individuals, which perhaps perform them only periodically. They apparently did not have a stimulating effect on fellow-rhino, for not infrequently not the slightest attempt was

made to sprinkle sand over dung deposited simultaneously or later beside such "buried" faeces.

Observations which perhaps indicate that the African black rhino (*Diceros bicornis*) also digs a hole in the ground before depositing its dung have been recorded by Ripley (1958), who writes: "The dung heap of the Black Rhino is always smaller and more scattered. In both species there is usually a depression in the ground to one side, or near the center of the heap. The defecating animal places its back legs in this depression and often stretches and kicks out with its legs alternately as it defecates, rather as a dog does. This depression then seems to be partly created by the animals, the ground perhaps being softened by their urinating at the same time. However, I believe it is often created secondarily by the visits of birds such as francolins and guinea fowl, mongoose, and large lizards, *Varanus* sp., all of which dig in the ground for seeds and beetle larvae".

This does not quite agree with what Guggisberg (1966) reports in this respect, for he says: "While defecating, the rhino puts up its tail and afterwards it scrapes the dung-heap, moving one hindleg at a time, not throwing it like a dog, but pushing it back and drawing it forward again. There are generally 3 or 4 scraping movements of each leg". He also writes, in contradistinction to Ripley's experience: "I cannot remember ever having seen a rhino urinate at the same time as it dropped its dung, as elephants very frequently do". Guggisberg's statements almost exactly agree with the author's observations with *Rhinoceros sondaicus* in Ujung Kulon.

In this sanctuary it was never discovered that a rhino had scraped with more than one hind leg, as Ripley seems to suggest, nor were indications found that other animals than the defecating rhino had made such holes.

The Javan rhino does not rub its hind feet in the freshly dropped dung as the African species are said to do (Schenkel 1969: 132), although from the above it is evident that occasionally the droppings were partly kicked to pieces. As far as the present author could establish the scraping performance in *Rhinoceros sondaicus* has no scent marking function as probably is the case in the African black rhinoceros, because in the majority of the cases the dung is not touched by the rhino's feet. Scraping could have that function if the rhino had urinated prior to or during defecating, of which the author did not obtain clear evidence.

Faeces in the water

Considerable attention was likewise paid to droppings deposited in the water, one of the reasons for this being that Hazewinkel (1933) wrote: "It is remarkable that I found so little badak dung on the ground, but mainly in the water", and Sody (1959: 206) also states on the authority of Evans that dung was often encountered in wallows frequented by rhino.

Only on nineteen occasions did the present author note droppings lying in the water, and some of these had been washed in there later as a result of heavy rain. Only twice was it established for certain that a whole dung heap, consisting of 20

and 23 balls, had been deposited in the water of a pool in the dunes i.e. not a wallow, and of a river. Not a single indication was found that rhino had defecated in wallows, but it is of course possible that the dung had been stamped into the mud of such pools or otherwise had been rendered unrecognizable by the activities of the wallowing animals. But, as the droppings float and also remain visible, even if they were kicked to pieces, there is little possibility of the Javan rhino's regular defecating in his wallows. On a number of occasions dung balls were found floating in the sea, but it was practically certain that they had been deposited on shore and had floated out on the tide. Schenkel (1967), however, asserts that the faeces which he found were very often deposited in rivers and pools, and later (1969: 115) he even goes so far as to consider running and standing water of rivers and rivulets one of the two places in which rhino preferably deposit their dung.

URINE

As stated in Chapter 15, it was possible to establish that rhino urinated in the wallow. During the process or shortly afterwards a violet-coloured cloud appears in the yellowish-brown muddy water, and the water then has the same smell as pervades a freshly deposited dung heap. The same penetrating odour also hangs around the spots (e.g. on the beach) where rhino have urinated on dry land, localities which otherwise would remain unnoticed; the author noted nothing of repeated urination at the same place.

Schenkel (1969: 117, 113, 132) writes: "Urination while lying in a wallow is derived from a reaction common to many mammals, to urinate when coming into contact with surface water"; "Urination in the wallow causes olfactory impregnation of the skin and thereby of the rhino's trail" and "besides, urination in the wallow contributes to scent-marking the rhino's paths". This may be true but also banteng, deer, tiger and many other mammals which do not wallow or only exceptionally, spread a peculiar odour making them at once recognizable, even for such a poor "nose-mammal" as is man!

In the Basle Zoo it was found that during the time that the cow of *Rhinoceros unicornis* is in heat large quantities of urine are sprayed around by both the cow and the bull (Lang 1961). Ripley (1952) suggests that this is always the case: "In addition, rhino project their urine with great force backwards and may discharge it over quite an area of grass and trees. It seems safe to assume that it is an important recognition signal to these animals whose power of scent is well developed. By analogy with other mammals the urine during oestrus would doubtless be recognizable to the male". The last point makes it apparent that the phenomenon does not always occur, but most probably only during oestrus.

Writing about the black rhinoceros, Guggisberg (1966) states: "As far as rhino bulls are concerned, the spraying over considerable areas is probably first and foremost a means of communication, getting it across to any cow coming that way that here is a gentleman who would not be averse to having a little bit of female company. I have never seen this intermittent spraying in females. The

cow's urine is also ejected with considerable force, but in the form of a liquid jet, not as an aerosol puff". The latter statement is in contradistinction to the one made by Ripley (1952) when speaking of *Rhinoceros unicornis*.

In Ujung Kulon places were repeatedly found where urine had been deposited, but the author never found any indication that this had happened otherwise than in the normal way. There is no reason to assume that such urine sprays would have been overlooked whilst the much less voluminous snorting marks discussed above were seen, the more so since enormous quantities of urine are said to be involved. Assuming that the phenomenon does in fact occur among Javan rhino, the absence of such observations might likewise suggest that the number of breeding pairs in Ujung Kulon is extremely small. Schenkel's (1967) experiences have already been discussed when dealing with the snorting marks. Later (1969: 116-117) he returns to the subject and writes: "... very fine droplets of reddish to yellowish urine cover the leaves up to two metres from the ground and in a range of three metres along the path. Obviously the shower of urine is spread backwards-upwards. Such sites of urination can occur in intervals of less than 100 metres on the path. Often the urine is squirted just after a rhino has passed through very dense vegetation". And "Smelly spots on the ground and large droplets on the vegetation near to the ground occur when urine is released in a downward splash." This almost exactly agrees with what Guggisberg (1966) writes in connection with the African black rhinoceros and which is also said to be the case with *Rhinoceros unicornis* (Lang 1961); however, the reddish to yellowish colour of the urine has never been reported and has been expressly denied in the case of the latter species in the Basle Zoo (see also p. 82). One is inclined to suppose that what are considered to be snorting marks by the present author are in reality proofs of the spraying of urine, but when discussing the snorting marks, the author has brought forward counter-arguments.

CHAPTER 13

INTERRELATIONSHIP, RELATIONSHIP TO OTHER ANIMALS. PRESUMED INTOLERANCE OF MAN

INTERRELATIONSHIP

As regards the interrelationship of the rhino, the author can state little more out of his own experience than what will be said below in Chapters 15 and 16. On the few occasions that the largest number—three—were seen or tracked together, they definitely or most probably included a mother and calf. The repeated observation of two male rhino, which lay for hours on the best of terms in a small wallow, often against one another, justifies the assumption that the interrelationship leaves nothing to be desired in normal circumstances (Plates 20-23, 28 and 29). At any rate there is not the slightest indication that they are intolerant of one another, if at least the skirmishing or fighting between two rhino of opposite sex, which presumably precedes mating, is excepted. Five or seven specimens of *Rhinoceros unicornis* are known to have wallowed simultaneously in the same pool; Gee (1953) published a photograph showing six rhino in such a wallow with a seventh standing by the side, without it, however, being clear of which sex these animals were. Elsewhere Gee (1964) writes that in such cases all rhino left that place singly and disappeared in different directions. Gee also learned that in certain circumstances unconnected with reproduction several animals could be seen together. On young vegetation that had sprouted after a fire he once saw six *Rhinoceros unicornis* in an area no larger than a normal football field, and in similar circumstances he often saw three or four together. On newly planted rice fields seven rhino were likewise once spotted within an area of about one acre. The present author does not believe that such a large number of *Rhinoceros sondaicus* will ever appear together in one and the same wallow or can be observed together otherwise, but it may not be excluded that this behaviour first of all is influenced by the small population of rhino during the entire period of his investigations. However, he has been able to establish that certain places were periodically visited by more than three different specimens in one and the same night. During 24 and 25 November, 1954, the prints of eight, perhaps 10 different individuals were found along the beach of the south coast. Five or six of these had visited that beach in the night of 24 November. Although somewhat less striking, that beach was also visited in other years by several rhino on the same night, for instance in October 1942, January 1943 and February 1952. This was likewise the case in September 1942 in the region between Niur and Tandjung Alang-alang and in November 1950 in the heavily wooded stretch of coast between Tjidaon and Njewaän. Although at all these locations the tracks of one and sometimes several rhino could be established, assemblages of more than two individuals were highly

exceptional outside the south coast. But since in all these cases distances of 5 to 15 km are concerned, and there is no proof that several rhino were there at the same time, one may perhaps not speak of concentrations.

Schenkel (1967) writes: "But although each animal moved on its own, there was repeated evidence that some connection existed between 2 to 4 individuals: their tracks were found in the same restricted area, though not together; and they left the area at the same time". In the present author's experience it is extremely difficult to establish on the strength of the tracks that "some connection" exists between 3 or 4 specimens. The presence of such a number or more individuals inside a relatively small area is often determined first and foremost by the presence of wallows and suitable food without there necessarily being any connection between the various individuals that visit such places. The experiences with the wallows described in Chapter 15 confirm this view. During the author's period of observation it was extremely rare for the tracks of three specimens to be encountered together in such a way that one could in fact speak of any connection, and in such cases this was most probably an adult cow in rut with a large calf that had been joined by a bull (Plate 32). A larger number of specimens were never tracked in a way that any connection between them could be postulated.

Groves (1967) is of the opinion that *Dicerorhinus sumatrensis* is a wanderer and *Rhinoceros sondaicus* not, because the Sumatran species is, or rather was, thinly scattered and found singly, while the Javan species built up large populations in a single area. The killing in Java of 526 rhinoceroses between September 1747 and January 1749, as reported by Sody, should testify to this, and also Horsfield's assertion that "it lives gregarious in many parts of Java". The present author believes that this assertion is not supported by sufficient evidence as far as Java is concerned. Also there is no proof that *D. sumatrensis* differs in this respect from the Javanese species. As far as Ujung Kulon is concerned, the Javan rhino may be considered a pronounced wanderer and there is no indication of a gregarious life, not even today, when all animals left are forced to stay within an area of barely 300 square kilometres. The need of wandering over large areas may eventually make Ujung Kulon too small an area for the species.

RELATIONSHIP TO OTHER ANIMALS

Since the author has never come across a rhino in the company of another larger species of animal, he is not in a position to say anything about how the rhino tolerates such animals. Spoor of one or more rhino were found with fair regularity alongside those of tigers, banteng and wild boar, but the author could not ascertain whether such tracks had been made at exactly the same time. Of course it would be unsound to conclude from the fact that on the beach of Ujung Kulon the brandnew track of a rhino was repeatedly observed with next to it, heading in the same direction, the fresh spoor of a large tiger, that the two animals had been walking side by side. Franck (1935) writes that from the tracks it could be very clearly established that both rhino and banteng had in some cases browsed on leaves,

bark and young branches *together*, but in the author's opinion this cannot be determined by means of prints or feeding marks.

During their nightly trips to and through their feeding grounds rhino will doubtless come into fairly regular contact with all other species of game living in Ujung Kulon; it does not seem probable that they will interfere with one another, any more than that they will forage "like brothers" side by side. Nor does there seem to be much reason for the latter, since with the exception of the barking deer none of these species is such a pronounced browser as *Rhinoceros sondaicus*. Franck's communication (1935) that the animals in this sanctuary are *often* encountered feeding in the early morning or late afternoon with a herd of banteng of both sexes is therefore highly dubious. Although browsing in the company of buffalo is not very probable either, the possibility seems greater, owing to the fact that the nature of these "water buffaloes" is much closer to that of the rhino; this can also be derived from the joint use of a wallow in the territory of Tjikawung (just east of Ujung Kulon) in June 1956.

The indications of peaceful coexistence are opposed by various others. Hazewinkel (1933) states that in South Sumatra bloody clashes sometimes occurred between a bull rhino and buffaloes or other cattle, usually ending in the death of or severe injury to a number of cows and bulls. Franck (1935) also wrote that the male rhino which he shot (in South Garut) greatly interfered with and attacked feral horses. Similar stories are also known from past centuries, so that such behaviour need not be doubted. These cases usually concerned rhino living in or near areas cultivated by man, and for this reason they are perhaps not suitable for justifying any statement of opinion regarding the relationship of this species to the other game sharing the same range in undisturbed localities.

PRESUMED INTOLERANCE OF MAN

When considering the rhino's aggressivity towards man, it is of course important in the first place to know to what extent provocation occurred. And since man and animal will certainly not give the same interpretation to this, we must be careful in accusing wild fauna of aggressivity, at least as far as non-carnivora are concerned. But, of course, it *is* possible to draw comparisons between the rhino's behaviour in this respect and that of other large mammals living in the same environment and in identical circumstances.

When doing this it is justifiable to say that *Rhinoceros sondaicus* is *intolerant* of man. This is the only species in the reserve by which the author has really felt threatened, without it having been his intention to do the animal any physical harm. A number of instances follow from which this intolerance may be derived, though without an actual attack having been made on the author or his companions, since this could not be risked because of the responsibility accepted for these people. In addition, in a number of cases the rhino encountered perhaps demonstrated a milder attitude. From the fact that during the time spent in Ujung Kulon the author passed the night in a tent on the ground (Plate 1) with

the exception of those nights spent in blinds constructed in trees to observe game (Plates 18, 19)—and was only once compelled to leave his bed by a charging rhino, it may perhaps be deduced that unprovoked attacks are not of common occurrence.

A description has already been given (Hoogerwerf 1938^b) of the encounter on 2 October, 1937, with a male rhino, which had obviously been startled by the author's arrival in the midst of a wallow and charged, after first disappearing in the opposite direction. Just as the author was engaged on measuring the prints close to the wallow he heard the animal returning, uttering a short "engguh-engguh" cry, and sought cover behind a tree about 50 cm thick close to the rhino's track. The bull ran on about 10 metres past the tree and then stood motionless, about 3 metres away from the rucksack which the author had slung down on that path, with his nose to the ground as if he was trying to wind the human intruder. Then he raised his head and continued to stand absolutely motionless for some time until he turned at full gallop via the wallow to the surrounding scrub jungle. Since the bearers had also taken refuge—quite some time before, in fact—none of the party was visible to the rhino, and it was probably due to this that no attack took place.

The event which occurred about a year after this encounter has also been put on record (Hoogerwerf 1939^c). This time it was two rhino which, shortly after sunset on 23 October, 1938, appeared from the fringe of the forest in the neighbourhood of a banteng cow shot that afternoon on which an autopsy was being performed. Working on this were the author, three other Europeans and eight Indonesians. After the snapping of branches in the surrounding jungle had announced the proximity of the animals, and caused almost everyone to seek refuge in a nearby tree, the two rhino appeared from a dense tepus (*Achras megalocarpus* [Zingiberaceae]) vegetation. Against the somewhat lighter background it was possible to make out with some difficulty a large rhino, with beside it a much smaller specimen, both of which stood motionless at the edge of the dense undergrowth. It will never be known whether it was the light from a flashlight, the smell of the shot banteng cow or the human scent that influenced the animal's behaviour, but soon afterwards the larger rhino, which proved to be a bull, charged, smashing into the tree in which most of the company had taken refuge. As he did so loud snorting could be heard. The huge animal then ran back and disappeared into the thick understorey together with the second rhino, whose sex could not be determined. Twice they stopped whilst retreating, and after a few dozen metres nothing more at all could be heard of them.

Again a year or so later, on 12 October, 1939, some Indonesian bearers had difficulties on a forest trail along which the author had been walking a quarter of an hour before. Once again it was two rhino, one of which, a large female, stormed out of the undergrowth and attacked the containers and a roll of canvas set down in the middle of the footpath by the bearers before they had fled up a nearby langkap palm. The rhino cow set about the baggage like a thing possessed for several moments, in which, according to the eye-witnesses, both the feet and the head played a part. As Plate 27 shows, the containers were severely damaged and a

great tear was made in the canvas in which the author's tent was packed. The men who witnessed this event stated that this rhino had a shoulder injury, perhaps caused when fighting the bull, which was seen in the surrounding shrubs but did not participate in the attack.

On 30 December, 1939, a male rhino was encountered in the midst of dense tjëntèh (*Lantana camara*) vegetation under higher trees. He gave himself away by the sound of his grinding jaws. After the author and his men had climbed a tree, the animal—with a branch of *Lantana* still in his mouth—appeared not far away from them, and remained motionless for about two minutes, obviously very much on the alert. He then walked a few paces backwards, and, after having covered about 10 metres in this manner, turned round, gave vent to a loud snort and ran off, stopping three times every 15-20 paces. It is the author's opinion that the rhino would have attacked if he had noted any human movement.

On 14 February, 1941, an attack again took place, this time after a skirmishing or fighting rhino pair had been observed for some length of time about half a kilometre away from the coast in the midst of a thick growth of *Ardisia humilis*. The author's attention was drawn to these animals by a frightening roar which he had never heard before and only a few times since (pp. 132-136). After these animals moved on to do battle elsewhere, the author left his seat in a tree to measure the footprints and to investigate the "battlefield". Suddenly he heard a rhino come storming through the understorey in his direction. He was able to save himself by clambering in great haste on a large block of coral among the fairly dense vegetation. The rhino, again a female, appeared immediately afterwards about 5-10 metres away from the coral block and charged several times, but presumably solely on the scent, for she ran around like a mad thing, sniffing and snorting, with tremendous force among the *Ardisia* stems as if she really had an enemy before her. Now and again the huge creature stood still, slowly moving her head to and fro as if she was scanning the surroundings, withdrew a few steps, walking backwards, and then rushed forward again. Immediately after this attack, which did not last more than one minute, the animal disappeared into the surrounding shrubs and then again had contact with the bull, at which the author had earlier had a good look and which he also saw again later, a colossal animal. In this case, too, the bull took no part in the attack, but kept well clear of the scene of battle.

What happened a few days later, on 19 February, 1941, was more or less analogous to the incident on 30 December, 1939, after a bull had jumped up out of a mudhole, stopped about 15 metres away from a tree in which the author and his men had taken cover and then walked back to the forest, but this time calmly, without any sniffing and snorting.

At 10 a.m. on 30 September, 1942, a large male rhino was encountered in a wallow; it was possible to observe this animal for some considerable time from a nearby tree. But soon the animal reared part-way up, listened and winded very intently, then shot out of the mudhole in panic, stood for a brief moment motionless beside it with his head turned towards the author, saw nothing and hurried off

right through some dense *Lantana* vegetation. In this case, too, it certainly did not look as if the animal had peaceful intentions.

An attack at which the author was not present took place at about 2 p.m. on 19 January, 1943. Two of his bearers, who were in a thick palm forest a few hundred metres away from the south coast in dull weather, had trouble with a pair of these animals once again. This time, too, the cow charged and the bull disappeared forthwith. The cow made a buffalo-like sound, which resembled "ccc-ccc". Both men were able to save themselves at the last minute by climbing a tree.

The only occasion on which the author and his men were obliged to leave their beds was in the night of 7 September, 1953; what happened bore some resemblance to the incident on 23 October, 1938, near the dead banteng cow. In those days they were making a trip right across Ujung Kulon and on the night in question had camped amidst heavy jungle about 1500 m away from the south coast. At midnight the late Dirk Faber, a soil scientist, was awakened by the sniffing of a rhino. He and the author cautiously left the tent; it later proved that the bearers had already left theirs some time before. The author took along with him the "Feuerhand", a small petroleum lamp, in an effort to prevent the rhino attacking and storming the illuminated camp, and so as to be able to see something of the animals as well. After the author had taken refuge behind a tree and then later by climbing a liana, two rhino appeared. They stood at the edge of the dense Zingiberaceae growth surrounding the small open spot of the bivouac, about 15-20 metres away. This time the bull charged repeatedly in the direction of the tents and the refuge later chosen nearby. He did this from various angles, and his charges were always accompanied by much snorting and blowing. However, the bull did not carry on to the tents, nor did he attack the tree affording the party cover, though sometimes he came so close that an extinguished cigarette stub flicked away by Faber almost brushed his flank as it fell to the ground. In this case, too, the animal usually walked backwards as he withdrew. The female, which was somewhat smaller, stayed in the background at first, but later also walked calmly in the direction of the party's refuge, uttering a soft buffalo-like cry. The activities of the bull did not seem to interest this female very much. The loud and threatening cry made by the bull during the attacks sounded like "proose-proose", "hoosh-hoosh" or "shoo-shoo", very different from the roar which the author had heard those skirmishing or fighting animals make in February 1941. When the animal had again withdrawn to the edge of the plateau on which the bivouac stood, the author and his men shouted, to which he reacted by snorting and some movement, but his charges did not seem to be influenced by this. It was over an hour before the rhino withdrew into the forest; the author did not sleep another wink for the rest of the night and the bearers did not leave their high perches until daybreak.

In this case too no harm was thus done to the author's property, but if the animals had seen people moving on the ground, they probably would have charged them. The next day three or four wallows were found in the vicinity which had not been recently visited by rhino, nor did the animals seen that night give the impression of having had a mud bath shortly before.

A few days later, on 13 September, 1953, a number of bearers were kept busy for about half an hour by a bull that appeared from the undergrowth about noon and took up a threatening position on a patrol path. Although in this case too the baggage had been set down on the path before the men took refuge in a tree, the containers remained undamaged.

The author again experienced a not very intensive attack on 27 November, 1954, after the fresh spoor of a rhino had been followed for some time. This animal allowed itself to be approached within a distance of about 10 metres, made a stand after the author and his men had climbed a tree and charged a few steps in their direction, uttering a loud "shoof-shoof". The animal then disappeared almost noiselessly into the dense vegetation.

An apparently aggressive attitude which was very similar to the experience on 30 December, 1939, described above was displayed on 5 February, 1956, by a male rhino. This animal too had approached within 15-20 metres of the author after noticing his presence and the latter had spotted the rhino through the loud chewing, which could be heard over quite a distance. With a few interruptions he ran through the scrub jungle, giving tongue to the familiar "hoosh-hoosh-hoosh", came to a stop in some thick *Lantana* vegetation, without much more being visible of him than most of the back and the constantly moving ears, and remained quite stationary for at least a few minutes. The rhino then again took a few steps forward, making the same sound, so that he was now standing at the extreme edge of the dense understorey, very much on the alert but still extremely well concealed. It may be difficult for the reader to realize how tense the atmosphere is at such moments and how safe one feels in a large tree a few metres above the ground. After a short time the unnerving "hoosh-hoosh" sound was heard again, the animal turned round and galloped off noisily, presumably without the intermezzos so often noted.

Hazewinkel (1933) states that rhino stamp the ground violently with their fore feet before attacking. However, the author has never seen this.

In eleven cases noted by the author no attacks or some behaviour pointing to an assault was observed; the animals involved were on seven occasions a bull and once a cow, whilst in three cases the sex could not be established. Ten cases involved rhino which stood on the ground, and once a specimen wallowing. Presumably, too, rhino which on two occasions approached the vicinity of the author's tents at night noticed the presence of human beings without launching an attack.

It is obvious to assume that rhino will not attack when they are in rivers, where they are almost always highly vulnerable, since the banks often do not offer any easy opportunities for flight. Something has already been published about this by the present author (Hoogerwerf 1938b, 1949). These were all cases (four) in which the rhino, taken by surprise in the water, did not attack; with the exception perhaps of what happened on 21 May, 1941, to the author's late friend Adrie Pfanstiel on the Tjigenter river when the animal (a bull) came dangerously close to the boat, so that those on board were terrified lest the colossus overturn it. A rhino surprised in a river near the bank on 11 October, 1941, ran away after it had

clambered out of the water with some difficulty. An adventure undergone by Faber in the afternoon of 16 March, 1952, on the same river where Pfanstiehl had experienced such an event almost exactly 11 years before, was perhaps just as dangerous. This animal, likewise a bull, did not enter the water until the flat-bottomed boat full of people had passed, then walked to the middle of the river (at that point 100-150 cm deep, with a hard bottom), sometimes standing still and "grunting like a wild boar". Partly because the party rowed away, the rhino did not come closer than about 10 metres to the boat. Those on board had the impression that the animal was attacking on their scent, since he nosed about so strangely in the river. The rhino then climbed up the bank and, making a deep flight spoor, disappeared into the forest, as could be reconstructed shortly afterwards by the present author from the track.

It appears from the above that not every rhino attacks, but that some specimens most probably do; perhaps they all do in certain circumstances. In a number of cases the rhino's behaviour could not be explained by the direction of the wind; more often the direction of the wind could not even be established. It is very difficult, and often quite impossible for human beings to determine local scent conditions when in the forest or amidst thick scrub jungle.

Hazewinkel (1933) also points to the inconsistency of rhino behaviour in this respect, and he is of the opinion that they are most dangerous in the rutting season and when the cow is accompanied by a calf, so that caution is called for if one tracks two rhino together. As regards specimens running alone, Hazewinkel thinks that in such cases it is mainly the old bulls and cows which attack, while younger animals usually keep out of a man's way. The author's experiences certainly do not contradict this, but rather confirm it, since attacks involving for certain the presence of two rhino could often be established.

Little can be said regarding the age of the solitary attacking individuals, for this can be estimated only if the animals are not yet fully grown; the author considers it practically or completely impossible to establish the age of really adult animals when in the field.

Among all hunters and poachers this species of rhino has the reputation of being highly aggressive, but this opinion is based on experiences often entirely different from the author's, who never hunted the animals. People living in the neighbourhood of Udjung Kulon know of many serious incidents in which attacking rhino were involved, but most of them may relate to frightened animals or to injured individuals, as most probably was the case with the accident met with by Van Raalte (p. 49). No particulars are available about the attack of a rhino on a pilgrim who entered the reserve during Schenkel's presence there. He writes (1969: 125): "During our stay in Udjung Kulon it was reported that a pilgrim out of a group on its way to Sanghijangsirah (southwestern tip of Udjung Kulon) had been attacked by a rhino in a bamboo thicket near Tjibunar. The man was said to have been bitten, knocked over and bitten again. He was seriously injured and had to be carried to the next village. The pilgrims had entered the reserve illegally and disappeared before we could clarify the incident."

The author cannot clear this rhino species of its bad name, although it will have become evident from what was said above that this aggressiveness may be less common than most hunters assume. On the other hand it cannot be denied that there is no large mammal known to the author which so often, and so closely, approaches human beings, instead of fleeing from this foe of all animals, as these pachyderms do.

When comparing the author's experiences with those of Schenkel (1969: 123-126) it is justified to include the great majority of the incidents in which rhino were assumed to attack, into the category of Schenkel's synopsis "Snorting and rushing in aggressive exploration". That the presence of human scent should reduce the probability of an attack, as Schenkel (1967, 1969: 118, 126) repeatedly asserts, is contradicted by at least eight of the cases enumerated above by the present author, very clearly in the events of 23 October, 1938, 12 October, 1939, 14 February, 1941, 7 September, 1953 and in those in the Tjigenter river of 21 May, 1941 and 16 March, 1952. Most probably human scent did also not prevent the attack of a rhino on a pilgrim reported by Schenkel.

With reference to the African black rhino Schenkel (1967) says that a confident bull, when he sees a man walking or running, may be stimulated to attack. "Obviously in such a case the strong optical stimulation can block the normal reaction to human scent for a short while." During the attacks or supposed attacks described above various incidents occurred which could not be explained by Schenkel's theory, since the rhino was unable to observe people moving. Although he stresses the fact (1969: 126) that "not only the initial disposition and the type of disturbance are essential; the reactions of both partners to one another shape the outcome", hardly any particulars are produced by him about the behaviour of the observer and his companions in the cases of encounters with rhino in this sanctuary.

Data have also recently become available concerning *Rhinoceros unicornis*, a species probably very closely related to the Javan rhino, indicating that during attacks contact with man is definitely not shunned. Gee (1953) has published a number of details on such attacks, some of which were definitely made without any provocation and all of which were on unarmed persons. None of the five attacks mentioned by him as having taken place (within a period of only two months) resulted in serious injury. In most cases it was the impression that the attacking rhino ceased to attack once the victim had been hurled to the ground. On one occasion a workman carrying a bundle of reeds on each shoulder was attacked. He was "scooped up" by a rhino and lay for some time on the back of the animal, which "trudged along forward very majestically" after the man had fallen beside the trail. However, later (1964) Gee writes: "Rhino can be very dangerous, and every year a few people get killed by them".

CHAPTER 14

FOOD REQUIREMENTS; BROWSE AND BROWSING AND ITS
INFLUENCE ON THE HABITAT

Although rhino are active both in the daytime and at night, most browsing takes place at night, which makes observations of feeding animals extremely difficult. Most particulars given below are based on spoor.

Although the list of plants at the end of this chapter gives almost 70 species as food of *Rhinoceros sondaicus*, it may be taken for granted that many more plants may be considered to be suitable forage inside Ujung Kulon. However, the list of the shrubs and trees which are the rhino's favourites in this sanctuary may well correspond to the real situation. When appraising this preference, density of occurrence of the plants concerned could not be considered to play a part in the majority of cases.

With some species, however, the frequency of occurrence does play an obvious role, for instance with the stinging pulus (*Laportea stimulans*), which in fact can only be described as numerous in certain parts of the south coast, where it is regularly eaten by rhino. Kemlandingan (*Leucaena leucocephala*), papaya (*Carica papaya*) and pisang (*Musa* sp.) might also rank higher on the list of the rhino's favourite food items if they were as universally present in such quantities as are for instance *Glochidion zeylanicum*, *Ficus septica*, *Desmodium umbellatum* and *Hibiscus tiliaceus*. *Loranthus* spp., too, would possibly be more important as rhino food if they were more easily obtainable, for to secure these parasites, which usually grow on trees or higher shrubs, rhino often go to a great deal of trouble, and considerable parts of this plant are generally very much eaten.

When studying this list more closely one is struck by the fact that there are no grasses or sedges among the enumerated species, but it is possible that this is not an entirely true picture. In view of the fact that grasses and grass-like plants are consumed in large quantities by banteng and deer, it was difficult to make out on the strength of clear tracks that this eating had also been done by rhino. Presumably rhino are not very keen on them. Only rarely was the author able to establish for sure that rhino eat other low herbaceous plants: *Stachytarpheta jamaicensis* and *Phyla nodiflora* only once each, and the mangrove thistle *Acanthus ilicifolius* five times, although all those plants are of common occurrence locally.

The devouring by this animal of the many palms (including the rattan species) found in a large variety inside the reserve is not in proportion to the density in which most species occur, although *Pandanus*, and in particular *P. tectorius*, seems to be eaten somewhat more frequently (Plate 37). The same may be said of the likewise very common Zingiberaceae, bamboos and lianas. Since in this case, too, all the plants that may be considered as belonging to these groups are eaten by banteng, deer and barking deer, the definite identification of rhino spoor was necessary here as well. But this was usually easier than in the case of grasses or

sedges since the nature of the substratum exerted a favourable influence when identifying the footmarks.

Schenkel (1969: 108) thinks that it is simple to distinguish the browsing marks of a rhino from those of banteng and other ruminants but the author does not agree with him. It is therefore possible that the list of rhino food plants published by Schenkel (1969: 109-111) contains species which in reality were *not* eaten by rhino but by other mammals.

Spiny or thorny plants, such as pandan, the swamp thistle *Acanthus ilicifolius*, randu leuweung (*Gossampinus heptaphylla*) and kuku heulang (the scientific name is unknown to the author), are apparently consumed without demur; this seems rather strange, especially as regards the last species, which has woody thorns some centimetres long. When speaking about *Dicerorhinus sumatrensis* Strickland (1967) points to the surprising fact that a *Melanorrhoea* species, known as "Rengas" in Malay, is among the food plants. Citing the botanist Corner he adds that these plants cause a serious rash or blistering upon contact with human skin; in cases of extreme exposure a high fever and even death may result; there is a *Melanorrhoea* species among the plants eaten by *Rhinoceros sondaicus* in Ujung Kulon. The blistering *Laportea stimulans* (pulus), is also a favoured forage plant in the reserve, and it is a surprising experience indeed for human beings to find that such repugnant species are devoured with pleasure by some animal.

Practically all the browsing established on the plants to be mentioned below related to shoots and twigs including young foliage (Plate 35), and the quantity consumed was, almost without exception, out of proportion to the damage done and the supply available. Although slight harm to the bast of small trees, saplings and shrubs as a result of the activities of rhino before or during feeding was common, bark-eating was only established once or twice. Nor has the author been able to establish with certainty any eating of roots. This does not tally with what Franck (1935) states; since he found fragments of bark in the stomach of a rhino (shot outside Ujung Kulon), foraging on bark may be regarded as proven. The fact that twigs and thin branches are often consumed is evidenced by the faeces, in which the woody parts stripped of the bark may almost always be encountered. In such cases those twigs were stripped of the bark in the rhino's stomach. Apparently thin twigs are not crushed during the process of chewing, as is perhaps the case with most twigs exceeding a diameter of 20 mm or so. Plate 41 clearly illustrates such food residues.

The branch thickness measured by the author on the living plant after having been bitten off by rhino usually varied from 10 to 17 mm, but in a number of cases this was considerably exceeded. On *Ficus septica* and *Dillenia indica* branches of 20 mm were found to have been consumed (Plate 35), on *Vitex negundo* branches of 25 mm and once a branch of a randu leuweung (*Gossampinus heptaphylla*) 45 mm thick was eaten away; this had not been devoured, but branches 15-20 mm thick had been. Browsing on still heavier pandan and some other non-woody plants was repeatedly noticed as well, but it does not seem of sufficient importance to list the diameter of such soft plants.

Only twice were seeds of the fruit of the kawung palm (*Arenga pinnata*) found in the faeces, and once small brown seeds, perhaps from *Desmodium umbellatum*, but the excrements were only rarely seriously investigated. Consumption was also noted of the fruits of kemlandingan, papaya and pisang. The author does not believe that in Ujung Kulon fruit forms an important item on the rhino menu. Leaves and other parts of plants mentioned above form the principal food, together with the bark of small branches, since these are always found stripped of the bast in the droppings; but in these cases the bark is not separated from branches and twigs until the digestive process takes place.

In order to secure its favourite food the rhino has in most cases to bring the tops of trees and shrubs within its reach. In the course of this, branches with a varying diameter are torn off and stems at different heights above the ground are broken or uprooted (Plates 34-36). Although it does happen that such serious damage leads to the destruction of the plants involved, this is a rarity, relatively speaking, since broken stems often prove vital enough to form new shoots, which are not infrequently consumed again later. The uprooted trees usually carry on growing too, since most often part of the root system remains intact. As a rule feeding rhino do not destroy their forage range, but shrubs and saplings on which they feed are kept low and within their reach, whereas the growth of new shoots is stimulated by the rhino's repeated return.

The diameter of the uprooted or broken stems and that of branches torn off generally varies from 10 to 15 cm, but more serious damage is by no means an exception; Schenkel (1969: 108) found in such cases a maximum diameter of 12 cm. Overturned trees thicker than 23-25 cm were not encountered by the author; in such cases the maximum diameter measured on reuheun (*Glochidion zeylanicum*) was 21-25 cm, and once an overturned kiparè (*Glochidion* sp.) with a cross section of 23 cm was found, which was about 9 m high. A branch broken off an *Artocarpus elastica* was 21 cm thick, and once a clump of six *Ardisia humilis* standing together, each with stems 12-15 cm thick, were broken off by a rhino just above the ground. Along the footpath that led to the lighthouse on Java's First Point severe damage was repeatedly found to papaya and pisang, which were usually pushed out of the ground, roots and all. Such damage was also done inside the enclosed garden of the Karang Randjang bivouac along the south coast, where incidentally the fence was also destroyed. The only papaya growing next to an overnight shelter at the mouth of the Tjikeusik (south coast) also met its fate.

The author feels that he may deduce from the spoor found that in most cases the branches are forced down with the neck and the underside of the head or by seizing them with its pointed upperlip or the jaws; the stems are knocked down by the shoulder or the breast. It may most exceptionally happen that the rhino walks lengthwise over a cracked or uprooted stem for the purpose of bringing it further down with the underside of its body; two indications in this direction were found on *Desmodium umbellatum*. If this were the usual way of getting a tree into an approximately horizontal position, then damage to the bark would have to occur over much of the tree's length by the belly rubbing against it, and similar

damage to the offshoots would be inevitable. Probably, too, in such a case the rhino would do its browsing on the underside of the tree-top and not on the outside, as was established almost without exception. The author never found clear evidence that the jaws play such an important part in bringing down heavy branches, as is supposed by Schenkel (1969: 107-108); traces of the teeth were found only rarely.

The author could never find certain proof that the rhino's feet play a prominent part in bringing down saplings or shrubs, nor were there indications that the animals stepped on them afterwards in order to break them into smaller units, as apparently was the custom of the *Dicerorhinus sumatrensis* studied by Strickland (1967).

According to J. Büttikofer, the Sumatran rhino eats shoots and leaves off stems, which are pushed down under the body, but he does not adduce any proof of this.

It is not impossible that sometimes the horn has a function in securing the food desired, since it may happen that thick branches are rotated around their longitudinal axis to an extent which one would not consider possible without their breaking off (Plate 36). In general the horn will play a minor role; if this were not so the females, which do not possess such a horn, would be very much at a disadvantage, which is hardly conceivable.

As a result of a large number of measurements, the following may be said regarding the height at which pushing marks for the purpose of knocking over trees, or feeding marks on trees and shrubs not knocked down, were encountered.

In collecting the data to be given below only those figures were used about which it was absolutely certain that they could not have been influenced in another way: rubbing or browsing marks on unstable, movable trees or branches were not measured, and it also had to be certain that they had not been made by banteng. In addition care was also taken that there was no confusion with earth raised by white ants (rajap).

In most cases the height of the pushing marks varied from 160 to 180 cm, but this maximum was exceeded not infrequently, and the greatest height was 256 cm. The results obtained on this point tally fairly accurately with the established height of the mud spoor on which figures were collected near wallows and elsewhere during activities which have nothing to do with browsing (p. 86).

At this great height of 256 cm pushing marks were found on *Glochidion zeylanicum*; at 250 cm on *Desmodium umbellatum*; at 217 cm on *Ardisia humilis*. On a *Gluta renghas*, which had a basal diameter of 18 cm and was broken off at a height of 50 cm, such a mark was found at 212 cm. Two pushing marks were also found on *G. zeylanicum* at a height of 210 cm and a feeding mark on *Vitex negundo* at the same height. Without there being any apparent indication that the branches chewed off had been pulled down first, the author found browsing marks at a maximum height of 250 and 260 cm. On a forked stem of a *Glochidion zeylanicum* there was a pushing mark at 190 cm, doubtless caused by the sides of the head before the underside of the head or the throat was used to tear apart the two arms of this fork, 40 and 47 cm in circumference, and the tree was pulled to the ground in two. This

clearly illustrates what enormous force a rhino can exert simply by pushing its head down. This force is also evidenced by the breaking and tearing from the tree of branches 12-15 cm thick at a height of 180-200 cm.

On a bungur (*Lagerstroemia flos-reginae*) there was a pushing mark at a maximum height of 170 cm with under it a slip mark of a length of 100 cm, and on a *Pongamia pinnata* a similar mark of 28 cm was found under a pushing mark at 185 cm. In these cases the slip marks were probably caused by vigorous movements of the rhino's head in the course of attempts to force down the tree with its lower jaw. The footprints also pointed to this. Only once was an indication found that a rhino had bitten into the stem under a pushing mark at 212 cm; the teeth marks were 185 cm above the ground. All pushing marks exceeding a height of approximately 170 cm may be caused by manipulations of the head.

Although the author has heard the noise made by rhino when breaking off food trees repeatedly at night and a few times during the day, he has never seen them in the act, so that the spoor found form the only indications. The enormous uproar made by this destruction can in certain circumstances be heard up to many hundred metres away, and the chewing sometimes scores of metres away. The fact that in terrain offering a good view the rhino browsed almost without exception at night did not make it simple to watch these animals at work.

Owing to the fact that the damaged trees and shrubs often survive and after some time put out new shoots if they were cracked or continue to grow in a horizontal direction if they were uprooted, certain localities are of a "rhino character". Before the war those areas were very strikingly present between the Tjigenter and the Tjihanduleum and in the area a kilometre or so north-east of the Njewaän. In such regions regeneration of the forest is of course hampered, so that they continue to form suitable forage ranges for the rhino for long periods. The absence of such extensive browsing localities in later years is perhaps one of the symptoms of a rapidly decreasing rhino population; this decrease was *not* the result of a shortage of the preferred saplings or shrubs.

Neglect of the pasturage necessary for the ruminants in Ujung Kulon increases the browsing possibilities for rhino, since the plants growing in such circumstances largely consist of favourite items of the rhino's diet, such as *Glochidion zeylanicum*, *Desmodium umbellatum*, *Ficus septica*, *Lantana camara*, *Tournefortia gigantea*, *Vitex negundo* and many other species. Conversely, the opening of new pastoral areas within terrains covered with a secondary vegetation might have an adverse effect on the forage range of the rhino. In view of the limited area of this pasturage, in the most favourable case at present about 50 ha, there is no reason to fear such an adverse influence, not even if 500 or 1000 ha of new pastures were laid out on behalf of the ruminant game. However, if on account of an investigation, suitable food plants of the species listed below should prove to be insufficiently present, rejuvenation of the food trees is necessary (see also Chapter 17).

Though there is no doubt that periodically preference is given to certain parts of the sanctuary for feeding, it may be said that almost the whole area is browsed, with a great preference for the low zones along the outside of the area. Ujung

Kulon may be described as an ideal forage range for rhino, since the species of plants which it seems to like most are available in large quantities, and maintaining these in a stage as preferred by the rhino is not too complicated a matter. Keeping favourable feeding areas in existence for the grass-loving banteng and deer is a much more serious problem.

In more or less direct opposition to the opinion recorded above on the favourable food position is Schenkel's (1967) view that there is a shortage of forage for rhino, and that as a result the animals are compelled to cover abnormally large distances. In his opinion this causes them to exert themselves unduly, thus having an adverse effect on the development of the population. In this connection Schenkel writes: "The present unfavourable condition may well be responsible for the apparent low incidence of breeding in the species".

Schenkel considers one of the measures that could improve this bad situation would be to reduce the sunlight-absorbing palm stands in order to stimulate the development of the saplings that the rhino need as food. He writes in this respect: "Above all, measures to efficiently increase the growth of rhino foodplants must be developed. In many places it is obviously the palm compound of the vegetation (Arenga, Salak) which prevents the growth of rhino foodplants".

Schenkel further supposes that also the decreasing banteng population may hamper the rhino's development, because this results in a shortage of well-developed paths that are also used by the rhino.

More recently an editorial paper appeared in *Oryx* (Anonymous 1968) in which similar statements are made.

The present author would like to make the following comments on the above. Concerning the path system maintained by banteng, it seems of some use to say that in this sanctuary banteng spend almost their entire life on the pastures or in the more or less parklike surroundings, in any case in a milieu not or sparsely covered with a dense or high secondary vegetation where the presence of paths is not of very great importance. Rhino, on the contrary, spend most of their days in thick scrub jungle or heavy secondary forest where they frequent their own paths. If the quantity of such jungle paths may have decreased during the last decades this must be attributed primarily to the drastic decline of these animals themselves without banteng having anything to do with that. In the author's opinion it is impossible that the well-being of this species of rhino, which is so excellently adapted to its preferable habitat, should depend to some degree on the banteng or that these ungulates should ever have a corresponding function. Also when considering the past of this reserve, the favourable influence from the side of the banteng seems very improbable, because it may be assumed that around the beginning of this century there were sufficient open pastures for the ungulates to feed on and little necessity to share the habitat of the rhino, and yet we may be sure that at that time the rhino population was in a much more favourable situation than nowadays. It may not be out of the question that the decreasing rhino population has detrimentally influenced their path system and may have hampered contact between the few individuals still present. But there is no other remedy a-

gainst this evil than to take measures aiming at the extension of the rhino stock, which can only be achieved through a watertight guarding system so that all our efforts should be directed towards this goal.

With reference to the assumed shortage of suitable rhino food, the author would like to make the following remarks. The list of plants given below can be seen to contain no or extremely few species that do not belong to a typically secondary vegetation. In any case these are plants that are encountered in Ujung Kulon in the zone of secondary vegetation *outside* the part of the sanctuary of which the palm stands envisaged by Schenkel form a characteristic component. *All the species* mentioned in the list to which rhino are most attracted occur in huge quantities in that zone between the hilly interior and the coast. It is possible that the small number of rhino still remaining does not suffice any longer to keep these food trees low enough, so that they grow beyond the reach of these animals, but even so that could apply to only a part of these plants, because a considerable percentage of them never reaches such a height (*Desmodium umbellatum*, *Pandanus* spp., *Lantana camara*, *Laportea stimularis*, *Acanthus ilicifolius*, *Leucaena leucocephala*, *Vitex negundo* and many other species). Moreover, there is a considerable chance that, through the serious neglect of the pasturage, which Schenkel repeatedly mentions, the number of saplings and other food plants sought by rhino has considerably increased, so that for that reason too there can be no question of a shortage of food.

In addition, the fact that Schenkel himself found the undergrowth in the higher parts of the Mt. Pajung range to possess a wealth of saplings may, in connection with the above, occasion surprise if rhino are in fact suffering from a shortage of food through the absence of such saplings in other parts of the reserve.

The "wasting" of food of which many other animals are guilty is not foreign to this species of rhino either. It is often striking how little such an animal consumes of a shrub or young tree which may have cost him considerable effort to reach. It is in addition a common occurrence that food plants of the same species and growing in the same neighbourhood are left untouched; the rhino does this also with the same or other food plants that he passes during a long walk, suddenly halting to bring leaves and shoots of a tree or shrub within the reach and to eat them. This natural ability and its fairly varied diet as far as the species of food plants are concerned may have contributed to the nomadic character of this animal. Most probably its nomadic nature is part of the normal pattern of behaviour that may have contributed to its survival; concentrations at one location and a great attachment to one area would form a great disadvantage for this vulnerable species. The nomadic behaviour also enlarges the possibilities of intraspecific contact which is of vital importance. Therefore, the author does not believe that rhino in Ujung Kulon "have developed a nomadic way of life and forage while on the move" because food plants are scattered and rather scarce according to Schenkel (1969: 131-132).

In view of the above the author feels that there is no reason to envisage a lack of food for the rhino. Felling of the monotypic palm stands must be advised against most strongly, also because this would harm the botanic value of the sanctuary:

the lowland forest there is after all the only stretch of any size reserved outside East Java.

If there were in fact a food shortage, it may be asked why the rhino did not leave the reserve long ago in search of supplies outside it, but Schenkel states that there are no rhino east of Ujung Kulon, and there are no other really reliable reports suggesting this either.

In this case too only one cause may be adduced for certain of the poor growth in numbers: the small number of individuals that poachers have left us now. Schenkel himself found clear evidence of poaching during his recent visits to the sanctuary; in August 1967 he reported: "On these trips we repeatedly came upon clear evidence of extensive poaching activity", and in a later report he assumed that in 1963/4 approximately 1/3 of the small remaining population was killed by poachers.

In the literature few details of the food taken by *Rhinoceros sondaicus* were found. Junghuhn describes the principal food as graminaceous species, including above all *Ataxia borsfieldii*,* which is at variance with everything that others say about the food. In addition the same author mentions a toadstool (*Agaricus rhinocerotis*) as a delicacy. Hazewinkel (1933) lists branches, leaves, lianas and strips of bark, and mentions the overthrowing of tjempedah trees (wild nangka) and the eating of maize. What he describes as a regular phenomenon, viz. the rubbing of the rhino's belly over the entire length of the uprooted tree, does not tally with the author's experience, as is evident from the above. Kerkhoven also states that the principal food consists of leaves and branches, with a special preference for various (not further specified) *Ficus* species. Franck (1935) mentions leaves and fruit, of trees and shrubs, again without giving names. Among the trees which he noted as having been knocked over, a stem diameter of 13 cm was apparently the maximum; in most cases such small trees had even been stripped of their bark on the upper side. Since Franck elsewhere mentions as food bark torn off the trees in long strips, it may be assumed that this was the cause of the bark-stripping, and not rubbing of the underbody of the rhino against these knocked-down stems. On account of his experience with *Dicerorhinus sumatrensis*, Strickland (1967) writes: "Many of the young trees that had been eaten had small bits of the bark scraped off about a metre from the ground. In a few cases I found trees that had been scraped in this manner but had not been eaten. I suspect this is one of the ways in which the rhino distinguishes the plants it prefers". In *Rhinoceros sondaicus* the present author has found some indication of this bark stripping in perhaps one case; incidentally this is one of the methods by which native tree experts in Indonesia classify tree species.

Sody (1959: 201) gives a number of other data on the food. Quoting S. Müller, he mentions young, thin branches, grass, etc., with particular preference for the leaves of *Ficus nivea*, *F. fistulosa*, *Acacia caesia*, *Omalanthus leschenaultiana* and various vines, the young sprouts and leaves of bamboo, glaga, alang-alang, etc. He also

* *Hierocloa* (= *Ataxia*) *borsfieldii* is a mountain grass occurring in Java from Mt. Papandajan eastwards between 2000 and 3300 m altitude.

quotes from personal communications to him young shoots of glaga (wild sugarcane) and bamboo, bast of trees (which the rhino tears from the trunk with its teeth), senkong, hamerang, bubuhan, tjengkeh, kĕnjĕrĕ (*Desmodium umbellatum*) and warĕng (*Gmelina elliptica*).

Among a number of plant species which, according to Sody, were mentioned by F. Allsop as eaten by *Rhinoceros sondaicus* living in Burma, none occur which the present author also established as food, although the list does include a *Dillenia aurea*, a *Mallotus (albus)* and several *Ficus* species. Leaves and twigs of these were eaten, and also the fruit of the first-mentioned tree; bamboo and grass species were consumed only to a very small extent. According to the same source, Evans lists a number of plants which are eaten by both the Javan and the Sumatran rhino: leaves, twigs, shoots, and—to a very minor extent—fruit, mainly in the dry season (wild mangoes and figs). The food plants on Evans' list are not found in Udjung Kulon, with the exception of *Ficus glomerata*, two *Dillenia* and a *Boehmeria* species. Among the 32 species of plants, of which 15 were classified generically only, found by Strickland (1967) as food of *Dicerorhinus sumatrensis* studied by him in Malaya, only 5 genera are also represented among the food plants in Udjung Kulon, viz. *Artocarpus*, *Ficus*, *Knema*, *Mangifera* and *Melanorrhoba*.

Mercalfé (1961) likewise mentions a number of species of plants which he established in Malaya as the food of *Dicerorhinus sumatrensis*. Mainly the leaves but on occasion the fruits of these plants as well were eaten. Among them are 5 *Ficus*, 1 *Mallotus* and 2 *Artocarpus* species, but otherwise the 24 species listed, belonging to 17 genera, did not include a single genus to which the species belong that were encountered in Udjung Kulon as food plants of *Rhinoceros sondaicus*.

In conclusion a list follows of the names of those plants which, in the author's experience, are eaten by rhino in Udjung Kulon, the number of observations being stated between brackets.

Since the first three common species have not been noted consistently because they were established so many times as the rhino's food, it is certain that the animal's preference for the saplings of these trees and shrubs is considerably more pronounced than the list may suggest. Perhaps also some other species, such as *Cordia subcordata*, *Dillenia* spp., *Eugenia* spp., *Ficus* spp., *Hibiscus tiliaceus*, *Mallotus paniculatus*, *Mangifera* spp., *Morinda citrifolia*, *Naucllea orientalis*, *Premna corymbosa*, *Pongamia pinnata*, *Sophora tomentosa* and *Vitex negundo*, are of greater importance as the rhino's food than is apparent from the list.

<i>Glorbidion zylanicum</i> (reuheun)	(23 = 12%)	<i>Dillenia indica</i> (sĕmpur)	(4)
<i>Desmodium umbellatum</i>		<i>Naucllea orientalis</i> (gĕmpol)	(3)
(kĕnjĕrĕ laut)	(19 = 10%)	<i>Acronychia laurifolia</i> (ki djĕruk?)	(3)
<i>Ficus septica</i> (ki-tjĭtat)	(15 = 8%)	<i>Tournefortia argentea</i> (babakoan)	(3)
<i>Pandanus</i> spp. (pandan)	(9 = 5%)	? ? (kuku heulang)	(3)
<i>Lantana camara</i> (tjĕntĕh)	(9 = 5%)	<i>Carica papaya</i> (papaya)	(3)
<i>Hibiscus tiliaceus</i> (waru)	(7)	<i>Leucaena hucocephala</i> (kĕmlandingan)	(3)
<i>Laportea stimulans</i> (pulus)	(6)	<i>Boehmeria pilosiuscula</i> or	
<i>Acanthus ilicifolius</i> (djĕrudju)	(5)	<i>Villebrunea rubescens</i> (nangsi)	(2)
<i>Loranthus</i> spp. (meugandeuhi)	(5)	<i>Ardisia humilis</i> (leumpĕni)	(2)
<i>Melanorrhoba wallichii</i> (ĕngas manuk)	(4)	<i>Vitex negundo</i> (katumpa empah)	(2)



Acrostichum aureum in a brackish water marsh in the Tjitjangkok area



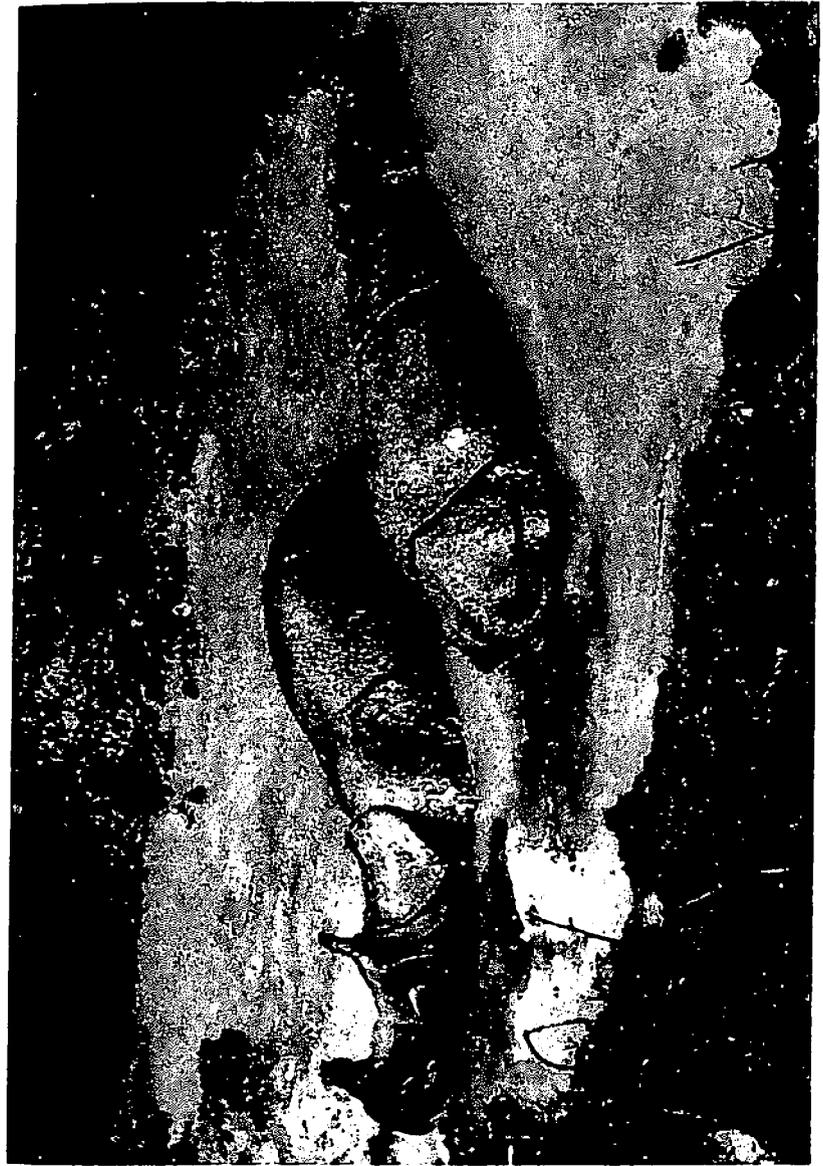
Observation hut in this swampfern-wilderness



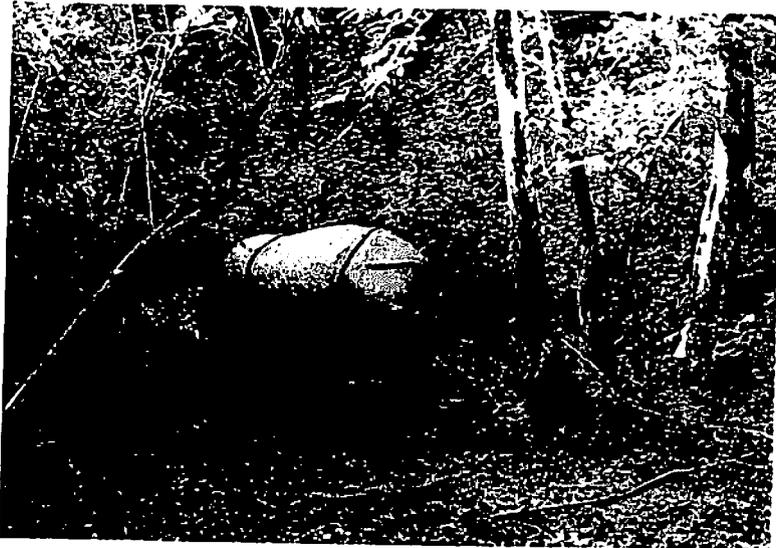
The same hut as pictured on Plate 18 in the Niur region; from this site most rhino pictures were taken



Rhino track along the Tjigenter, presumably used by many generations of these pachyderms



One of the first photos taken from the blind pictured on Plate 19; both were bulls but symptoms of mutual intolerance were not noticed



The usual retreat to a safer refuge when the sun rises



As if surprised the other eyed him but did not follow

<i>Eugenia</i> sp. (kopo)	(2)	<i>Pipturus repandus</i> (areuj leuksa)	(1)	
<i>Croton argyratus?</i> (djaha?)	(2)	?	(areuj gegompangan)	(1)
<i>Alstonia scholaris</i> (lamé)	(2)	<i>Musa</i> sp. (pisang)	(1)	
<i>Cordia subcordata</i> (këndal)	(2)	<i>Dillenia excelsa</i> (sègl)	(1)	
<i>Pempbis atidula</i> (tjantigi)	(2)	<i>Calamus</i> spp. (rattan)	(1)	
<i>Aranga pinnata</i> (kawung) seeds	(2)	<i>Schima noronbas</i> (puspa)	(1)	
<i>Acbasma megalocbilos</i> (tèpus)	(2)	<i>Phyla nodiflora</i> (?)	(1)	
<i>Lagerstroemia flos-reginae</i> (bungur)	(2)	<i>Aporosa arborea</i> (kikuja)	(1)	
<i>Antidesma bunius</i> (woeni)	(1)	<i>Anacolosa frutescens</i> (kopi leuweung)	(1)	
<i>Cryptocarya ferrea</i> (kaju huru)	(1)	<i>Kadsura cauliflora</i> (hunjur)	(1)	
<i>Mallotus paniculatus</i> (tjalik angin)	(1)	<i>Mangifera caesia</i> (kemang)	(1)	
<i>Stachytarpheta jamaicensis</i> (djarong)	(1)	"	(gunir)	(1)
<i>Ficus variegata</i> (kondang)	(1)	<i>Gossampinus heptaphylla</i> (randu leuweung)	(1)	
<i>Glochidion</i> sp. (marè mè)	(1)	<i>Ficus glomerata</i> (lows)	(1)	
<i>Glochidion</i> sp. (kiparè)	(1)	<i>Gluta rengbas</i> (rènghas)	(1)	
<i>Calophyllum inophyllum</i> (njemplung)	(1)	<i>Casuarina equisetifolia</i> (tjèmara)	(1)	
<i>Bridelia monoica</i> (kènjèrè gunung)	(1)	<i>Blumeodendron elateriospermum</i>	(1)	
<i>Morinda citrifolia</i> (tjangkudu)	(1)	<i>Knema glauca</i> (kimokla)	(1)	
<i>Cinnamomum iners</i> (tèdje)	(1)	<i>Sophora tomentosa</i> (bungbualan)	(1)	
<i>Diospyros macrophylla</i> (tjalung)	(1)	<i>Mimusops elengi</i> (ki tandjung)	(1)	
<i>Ariocarpus elatita</i> (teureup)	(1)	<i>Premna corymbosa</i> (lamétang)	(1)	
<i>Corypha utan</i> (gèbang)	(1)	<i>Lantium humilis</i> (ki untjal)	(1)	
<i>Leaa angulata</i> (ki buuja)	(1)	<i>Casia timoriensis</i> (haringin)	(1)	
<i>Calotropis gigantea</i> (biduri)	(1)	<i>Pterocymbium javanicum</i> (tongtollok)	(1)	
<i>Pongamia pinnata</i> (malapari)	(1)	<i>Eugenia</i> sp. (salam)	(1)	

Very recently Schenkel (1969: 109-111) published a list of 95 plant species on which rhino in Ujung Kulon are said to feed. The meaning of the +, ++ and +++ used in the column "Frequency of feeding" of that synopsis is not explained in the paper, but according to a communication to C. G. G. J. van Steenis these indications should mean "occasionally", "more often" and "very often".

The great majority of these species are absent in the author's list but among them only 17 species are reported by Schenkel to have been found as the rhino's food in more than one case. They are: *Bombax malabaricum* (dangdeur), *Bridelia stipularis* (kanjere), *Claoxylon polot* (talingkup), *Diospyros macrophylla* (kitjalung), *Ficus callosa* (pangsar), *Ficus fistulosa* (beunjing), *Garcinia celebica* (manggu leuweung), *Garcinia dioica* (tjeuri), *Leaa indica* (sulangkar), *Lepisanthes* sp. (kilalaju), *Mallotus philippinensis* (kimejong), *Pterospermum* spp., *Spondias pinnata* (kedongdong), *Taxotrophis taxoides* (ulit), *Vitex pubescens* (laban) and *Xanthoxylum rhetsae* (kitanah). On the other hand there are 54 species in the list of the present author that are not mentioned by Schenkel, of which 17 have been established more than once as the rhino's food. Among these 17 species is *Glochidion zeylanicum* (reuheun), found by the author to be the rhino's most favourite food; there are several others that may rank high on the list of the rhino's preferred food items, viz. *Acanthus ilicifolius*, *Cordia subcordata*, *Lantana camara*, *Leucaena leucocephala*, *Loranthus* spp., *Melanorrhoea wallichii*, *Nauclea orientalis*, *Pandanus* spp., *Vitex negundo*. It is not likely that during the last decade changes in the vegetation took place to which these discrepancies may be attributed, so that their missing in Schenkel's list remains a mystery.

Schenkel's synopsis confirms the statement of the present author that rhino in Ujung Kulon mainly feed on trees, shrubs, etc., of secondary growth, of which large

quantities are available in the sanctuary. Confining ourselves to those plants which have been found as the rhino's food more than once, the following species of Schenkel's list are worth mentioning: *Achasma coccinium* (tèpus), *Bridelia* spp., *Desmodium umbellatum* (kanjere laut), *Dillenia* spp., *Eugenia* spp., *Ficus* spp., *Glochidion rubrum* (kipare), *Hibiscus tiliaceus* (waru laut), *Lagerstroemia flos-reginae* (bungur), *Laportea stimulans* (pulus), *Leea indica* (sulangkar) and *Tournefortia argentea* (baba-koan). There are at least six species which never grow beyond the rhino's reach.

When considering all 58 species found by Schenkel and the present author more than once as the rhino's food, there are no fewer than 38 species typical of secondary growths, of which a great majority is abundantly present in Udjung Kulon. According to Van Steenis (in litt.) who studied Schenkel's list, there are only 11 of the 95 species which are not or only rarely found in secondary growths and among these few species there are only two (*Diospyros macrophylla* and *Lepisanthes* sp.) which have been found by Schenkel more than once as the rhino's food.

It is therefore incomprehensible that Schenkel (1969: 131) suggests that this sanctuary does not fully meet the rhino's food requirements. He again writes: "Only as to food plants the habitat does not appear optimal. The saplings of the plant species on which the rhino feeds are widely scattered and not frequent. Nowhere in the reserve larger stands of foodplants are found." And (1969: 133) "... preferred foodplants occur widely scattered and are rather scarce. In many parts of the reserve plant communities have developed which do not permit saplings of rhino foodplants to develop."

Since there are many food plants which never grow beyond the rhino's reach the author considers it out of the question that there should be a shortage of suitable forage. *Achasma* spp. are abundantly available almost everywhere in the sanctuary and Schenkel himself (1969: 105) mentions *Laportea stimulans* a dominant species in parts of the dune-like ridges along the south coast. Here and almost everywhere else in the reserve also *Lantana camara*, *Pandanus* spp., *Desmodium umbellatum*, *Vitex negundo* and many other food plants known as the rhino's favourites are abundantly available, also in areas where the vegetation apparently reached its climax.

CHAPTER 15

WALLOWS AND THE RHINO'S BEHAVIOUR IN AND AROUND THEM

It may be considered sufficiently well known that the presence of wallows is of vital importance to all three species of Asian rhino. Thanks to the large number of "pangujan", as these mudholes are called by the inhabitants of Bantam, Udjung Kulon offers extremely favourable provisions for *Rhinoceros sondaicus* on this point too. During lengthy droughts, when the wallows cannot be used by the rhino, the many muddy river banks and edges of the tidal forests assume the function of these mudholes.

Such wallows are found almost everywhere in the reserve, fairly evenly distributed, most often at places which are inconspicuous to the casual visitor. They probably owe their origin, and certainly their continued existence, to the activities of the rhino; it is fairly certain that wild boar and monitor lizards also play a part in this.

Although it would be obvious to assume that these wallows are to be found above all in the lowest parts of the reserve, this is by no means the case; most of them are located on low hills and ridges built up from marly soils and therefore with a high lime content. But one thing they have in common is that they are usually well concealed among the vegetation and are a good distance away from the coast, though there are a fair number of exceptions to this (Plate 33). It is not unusual for the pools to lie in the midst of almost impenetrable masses of salak, rattan, bamboo, rahashas (*Mapania* sp.), swamp ferns (*Acrostichum aureum*), etc., and usually one's attention is drawn to them by the tracks leading there or the mud marks on trees or bushes in the vicinity. If they have been recently visited by rhino, they can often be smelt dozens of metres away. This smell is reminiscent of that of a large quantity of fresh horse dung. Elsewhere, too, the smell usually betrays the place where such an animal was recently to be found, and it is particularly penetrating if the rhino urinated or (to a lesser extent) defecated or left its "snorting marks" on the ground cover and other undergrowth.

The wallows are usually not more than 6-7 m long and 3-5 m wide; smaller ones are not uncommon. They are usually no deeper than 50 cm down to the top of the layer of mud, which is 50-75 cm thick, and they are filled by the rains almost without exception. If the rains do not come, the water level falls quickly and soon little more is left than a porridgy mass of mud, which soon loses its attraction for the rhino and finally dries extremely hard (Plate 27). Wallows with salt water were not found, and ones with brackish water were infrequent, although "open bathing-places" in the banks of rivers or creeks containing salt or brackish water are not exactly rare, but they cannot be called wallows. Almost all the wallows inspected by the author gave the impression of being of old date, among other things through

the tracks leading to them and the years-old traces on "rubbing trees", which were often misshapen through contact with the heads and horns of wallowing rhino, and through maltreatment as a result of rubbing after the rhino had left the wallow (Plate 33). It seems as if certain places along river banks were visited by rhino at irregular intervals for years (Plate 19), but it is probably more usual for them to visit the rivers at random places. Visits to rivers are doubtless more frequent during long periods of drought, but are also paid when an adequate number of mudholes are everywhere available.

It is probable that these wallows came into being at times when there was a much larger rhino population than ever was encountered by the author, so that the rhino still remaining have at their disposal a proportionately much larger number of mudholes than must have been the case formerly. Perhaps this is the reason for the small number of visits now paid to most of them, and the sometimes very long periods during which they are not visited at all. But F. Allsop (Sody 1959: 204) also reports with reference to *Rhinoceros unicornis* that the latter ignores certain wallows for long periods—he even speaks of 1 to 2 years—so that it may be a normal phenomenon after all.

In December 1940, January and February 1941, when the author obtained the first good series of photographs (Plates 20-29) and films ever made of *Rhinoceros sondaicus* in its natural habitat, the wallows under observation were visited by more than one rhino on all five of the days and five out of the ten days respectively on which they were kept under continuous observation, but all other, numerous attempts made to observe rhino in recently used wallows failed. This may have been caused by the author's arrival disturbing the environment, although the greatest caution was exercised. But disturbances were apparently not considered very important by the rhino in January/February 1941, for then it repeatedly happened that they walked over the author's footprints, made a few hours or still shorter before, while on their way to the wallows. After the last rhino had been seen in the vicinity of these mudholes in the night of 17 February, the author waited in vain four days and nights, and probably these two "pangujan" were not visited again by the animals for more than a year; later, too, they were not regularly visited (perhaps not at all) by rhino with a fair degree of certainty up to and including 1956.

Although on numerous occasions rhino were encountered in such wallows or along the muddy banks of rivers, it is difficult to say anything definite about the hours at which visits to such places are most frequent; observations suggest that visits occur at almost every hour of the day or night. Perhaps they are least frequent during the early night and the late morning hours, depending on the locality; experience shows that wallows located close to the coast and those which are not protected by dense vegetation are visited most rarely, if at all, during the day. However, nighttime observations are relatively limited, or at least much less numerous than those by day, which calls for caution in drawing conclusions.

Schenkel (1967) noticed rhino using wallows only at night, and never during the day, which therefore differs considerably from the present author's experience.

Later Schenkel (1969: 112) confirms this statement: "During our study we found at daytime only once a rhino lying in a river basin and three times in a mud wallow; in two other cases the animal had become alarmed and taken to flight before we could see it." However, he also writes: "We found them usually at noon resting in dense vegetation or lying in a wallow or—rarely—in a river basin" (Schenkel 1969: 120-121).

As stated, in December 1940/January 1941 and again in February 1941 five and ten days respectively were devoted in succession to the observation of two wallows located on low hills, about 800 metres from the coast in heavy secondary forest with an unclosed canopy. All the rhino pictures in this book were taken there. These were the only occasions on which the author succeeded in observing rhino well and for long periods almost every night, although this was attempted many times at the same places and elsewhere with equal caution, patience and perseverance. The rhino were observed from nearby trees 4-6 m high, using platforms made from branches on which a small tent was erected (Plate 19), in which the author spent several days and nights in succession all on his own almost without setting foot on the ground.

The course of events at these places is briefly described below, since it gives a good picture of rhino activities in and around such wallows.

On the first day when this series of observations started, 31 December, 1940, at 6 p.m., a male rhino arrived at the open place where the wallow was situated via a track lying opposite the author's blind. After pausing a moment on the high bank, the animal walked to the edge of the almost full pool, drank a little and then stepped into the wallow. However, this was too shallow for the rhino to disappear into entirely, with the result that much of his back and head protruded above the brownish-yellow water. The rhino, which was about 35 metres away from the blind, behaved quite calmly, as witness the fact that now and then he rolled in the mud, so that his head disappeared entirely under water with all four legs upwards. After about three-quarters of an hour the animal may have got a faint scent of the author; at any rate he became alarmed, left the wallow at an unimaginable speed and rushed into the jungle. Once the colossus was about 20 metres away and in the forest, he stopped for a moment and half-turned to look behind him, whereupon he galloped out of sight immediately afterwards. During his flight no sound was noted, but later a rhino could be heard snorting and also breaking branches.

Although the author thought that as a result of this animal fleeing almost in a panic his chances of seeing other rhino at this spot were gone, this proved by no means so, for at 6.30 the next morning again a male rhino appeared in the wallow, where he remained in apparently complete relaxation until about 8 a.m. At that time the animal climbed out of the pool, walked to about 7 metres from the tree containing the author's blind and suddenly became alarmed. He took a few short "angry" steps in the direction of that tree, blew as if about to attack, turned round quickly and ran (via the wallow!) snorting into the forest.

This was almost certainly another rhino than the first one, since he was larger, with a bigger horn. But in any case this was the second time within 12 hours that a

rhino had left the author's surroundings in an alarmed state. That whole day—i.e. New Year's Day 1941—nothing further happened, and all was also still during the early part of the night that followed, but at about 5.20 in the morning of 2 January the author was awoken from a light slumber by a snort uttered twice in close succession, sounding like "woo-woo", whereupon as answer a "buffalo-like cēch" rang out from the wallow. When the scene was illuminated with a powerful headlight a rhino bull could be seen lying in the mud and a second one, likewise a bull, was on the point of stepping in. This artificial light did not disturb the animals in the slightest, and soon the two rhino lay "fraternally" side by side in an overfull wallow out of which the water displaced by the gigantic bodies ran down the hill via a narrow gully. During the four hours and more that they spent in that wallow there was not the slightest sign of anything but an amicable relationship or of any disquiet on the part of the animals (Plates 20-23). Once again much of their backs and heads protruded above water, the heads were occasionally ducked right under the surface and now and again they rolled over like horses in a field, their heads right under water, the soles of their feet upwards. Sometimes, too, their bodies swayed to and fro, and they "sat up" (Plate 22); in the latter position they urinated, as could be seen from the violet flow in the water of the wallow, which normally had a yellowish-brown tint. The rhino also lay on occasion with closed eyes, or yawned, thus creating the impression that they were completely at their ease and were resting in this way. However, something showed that they were always on the alert, evidenced by the constant movement of the ears, which probably play an even greater part as warning system than the nose. No sound was heard during this bathing beyond an occasional, not loud "cēch-cēch", probably emitted only by the specimen with the larger horn. After the rolling sessions in particular the rhino's whole body was so covered with mud that only the nostrils, the ears and the small eyes remained properly visible; the rest of the body resembled a colossus modelled from soft clay, in which large raindrops made crater-like holes.

Not until 9.30 a.m. did the larger rhino get up out of the muddy water; he was probably alarmed, for he ran around a bush near the wallow, but then walked back down to the hole, perhaps because the first animal continued to lie perfectly at his ease in the mud. Apparently quite calm, this larger specimen was soon "sitting up" again by the side of the wallow, and at a given moment he was even lying with all four feet under him at the edge of the pool. Soon afterwards the second bull also stood up out of the mud and then the two animals began to butt each other with their heads (Plate 24). But after less than a minute the larger one turned and, appearing quite calm, walked into the forest (Plate 25). The second one, still in the water, crept back into the mud but also left the spot about a quarter of an hour later, disappearing in quite a different direction from the first one.

Although there is no certainty on this point, it is probable that these two rhino, obviously differing in size of body and length of horn, were the same specimens observed earlier at the same spot. If this assumption is correct, the rhino which had been previously alarmed had nevertheless returned to the same place; however, it is not certain that this alarm was caused by human scent.

A certain unconcern, which in actual fact is at variance with everything that has so far become known about this species and which also greatly surprised the author, was again evident on that same day after the latter rhino had disappeared into the forest about 10 a.m. Half an hour later the author left his tree, for the first time in two days, among other things to examine the tracks left by these animals more closely and, insofar as possible, to measure them. About 10.45 a.m. he was back in his blind, and barely fifteen minutes later a cracking noise was again heard in the forest, followed almost immediately by the arrival of a rhino bull, which crept into the wallow without any hesitation. The animal was still partly covered with wet mud, and was obviously the smaller of the animals which had left an hour before. The larger one appeared shortly afterwards, but this one was more cautious; he pressed his nose against the ground, sniffed twice and ran back to the forest, this time closely followed by the smaller bull, which now was obviously properly alarmed. The latter had therefore evidently winded nothing of the author's tracks at first and did not become alarmed until he perceived the manoeuvres of the bigger bull. Perhaps this was a result of the very gloomy weather and the heavy rains, which poured down almost incessantly, thus blurring the human tracks.

The most interesting incident occurred the following night. At 1.30 a.m. the author awoke after a short rest and saw, with the water as background, a large rhino standing beside the wallow and a very small specimen in the latter! Soon afterwards the large one took to the water, and not until then was the headlight switched on, making it possible to observe the two animals until dawn broke. They were a particularly large mother with a small calf which may not have been older than two or three months, though not younger because—as was found later—its foot was about 16 cm wide and its fore hoof about 8 cm, which sizes are probably too large for a new-born calf (see p. 139). It was the only small calf that the author has ever seen, since it is almost certain that it was this calf that also was observed on some later occasions (see below).

The behaviour of the old rhino in the wallow in no way differed from that described above for the bulls. But, unlike these rhino, the cow lay almost constantly with her head in the direction of the blind. She lay more frequently with the whole of her head on dry land but—like the others had done—she also rested on her side in the mud, rolled over, moved her head up and down, etc. It sometimes seemed as if both animals were sleeping, so great was the silence; they were then snuggling down in the mud in a most lazy fashion, but the mother was listening and winding at very regular intervals. Her ears were almost incessantly on the go; the same applied to the calf, whose ears seemed too large for its small head when a rhinoceros hornbill flew over in the early morning with a loud swish of its wings. The calf usually lay against the flanks of the cow, but not infrequently practically a metre away from her. Although it tried to roll a few times, this proved unsuccessful, perhaps because the small body could not get a sufficient hold in the too deep mud. The mother was ultimately covered with mud to such an extent that her eyes could not be distinguished even with binoculars. At dawn the female rhino climbed out of the wallow, immediately followed by the calf, which began to take

suck at once, probably from a kneeling position. But after a few minutes the pair returned to the water. However, presumably slightly alarmed, the mother climbed back on the bank again soon afterwards, though she returned to the mud after she had winded and listened in the direction of the blind with her head slightly raised. All that time the calf had remained quietly lying in the water.

It was not until about 7 a.m. that the animals again prepared to leave the wallow; this caused the large female considerably more trouble than her male counterparts, for when she raised herself up on her fore feet along the edge of the mud-hole, it was only after some effort that she could also drag her hind feet out of the soft mud. She jerkily drew then the one, then the other foot out of the sludgy mass and immediately afterwards, with the calf close behind her, followed the trail back to the forest. Sometimes the calf pressed itself against its mother's rear flanks, took fright for a moment and looked back tensely, but for the rest both animals withdrew most calmly into the forest, which was not thick and nowhere came closer than 5 to 10 metres to the wallow. The author did not hear the cow make any sound, but the calf occasionally emitted a quiet cry, which might be compared to some extent to the soft yelp of a dog. These rhino had therefore remained even longer in the wallow than the two bulls the day before, viz. about six hours.

It was most unfortunate that it was impossible to film or photograph the events which occurred, also in good light between 6.30 and 7 a.m., since all the films and the photographic negatives had already been used up!

At 10 a.m. the author left the blind, returning at 5 p.m. Partly as a result of the rhino urine the wallow could now be smelt from a considerable distance away, and sitting in the blind up the tree the author had unpleasant proof of the fact that he was well out of the wind for rhino in the wallow. The colour of the water was that of tea with very little milk; no faeces or traces of them were found in the wallow, which was a common phenomenon elsewhere in Ujung Kulon too.

About 8 p.m. that evening—still 3 January—mother and child reappeared; the author assumed that they were the same, although in the morning the only characteristic which it had been possible to establish on the animals, with their thick coating of mud, was their size. Even before they had reached the vicinity of the wallow the couple drew attention through the loud cracking of dry branches. Without any visible hesitation the cow entered the water, immediately followed by the calf. This time the mother left the wallow after only half an hour, followed shortly afterwards by the calf, but not until the female was already walking along the wide, slightly sloping track to the forest, as a result of which it was a few metres behind, a rather risky business for the little one.

During the following afternoon and night the author was again in his tree, and once more not in vain, though it was not until 2 o'clock the next morning that the first rhino put in an appearance. As the batteries of the headlight were now flat, the sex of this rhino could not be established in the dark, but it is believed that it was a cow. Although this rhino also wallowed, it did so for a short time only, probably because the animal was alarmed by human scent; it stood by the mudhole for a short while, uttered a loud snort and vanished. During its wallowing this animal

also lay with its head turned towards the blind, and it could be heard breathing from at least 30 metres away through a snort that was repeated every 5 to 7 seconds.

When the author was thinking about leaving his observation post at about 7 a.m., another rhino bull appeared which, however, walked quietly past the mud-hole to the forest. It did not visibly appear to pay much attention to its surroundings; none of its senses seemed to be particularly active. The author noted in his diary: "Rhino apparently roam around here like pigs elsewhere...". He left the blind at 8 a.m.

About a month later, on 9 February, having returned to this spot, the author established that the wallow had already not been visited by rhino any more for at least a week, but probably longer, but the prospects seemed more favourable at another wallow located on a nearby hill where very fresh tracks were found (Plates 28, 29). This was a good guess, for after the author, at 4 p.m., moved into his blind (again in a tree) which had been built the previous day, a male rhino appeared at 6.15 p.m. He made for the "pangujangan", had a quick drink and then disappeared again in the direction of the coast.

The next morning, about 3.30 a.m., approximately the same scene repeated itself as had taken place at about the same time on 2 January in the other wallow. The author was awakened from a light sleep by the clear snorting that again accompanied the animal's breathing; he lit the headlight and the light was reflected in the colourless eyes of a male rhino without any reaction being perceptible. Two hours later a second bull appeared, probably a specimen never seen before, with a long and pointed horn. After the author had plainly heard this rhino chewing directly under his seat, silence fell, after which a short snort was heard a few times, as if the animal had become alarmed. This was answered from the wallow by a strange squeaky sound not heard before. But quite some time elapsed before this rhino also emerged from the surrounding jungle and then went straight to the wallow. Both bulls afterwards lay in the water, blowing rather noisily, both through their nostrils and from under their tails. They now urinated while lying normally in the wallow; this was again immediately noticeable through a violet cloud in the brown water. Not until 10.30 a.m., that is to say after lying in the mud for five hours, did the large specimen step out of the wallow. He walked over to a rubbing tree, which had probably done service as such on countless occasions, and spent several minutes rubbing the mud off his sides, feet and head, leaving thick lumps of mud on the trunk (Plate 28). Without eating, the animal made chewing motions, in the course of which his narrow, thick tongue occasionally protruded from his mouth. Although his fellow, who was still lying in the wallow, seemed to notice something of the author's photographic activities, nothing alarming happened, for shortly afterwards he too climbed on to dry land and strolled over in the calmest possible fashion to the somewhat larger bull. The animals then butted their heads against and past one another for a while (Plate 29) before the bull which had been the last to leave the mudhole calmly vanished into the forest. Not until about 10 minutes had elapsed did the second follow; on this occasion, too, each one thus went his own way just as had been noted a month before. Soon afterwards a loud

snort coming from a considerable distance away was heard, followed by a roar like that of an angry banteng bull but with a much more ominous sound to it. It tallied with the roar which was heard in the same neighbourhood some days later in skirmishing between two rhino of opposite sex (Chapter 16).

When the rhino had departed there was hardly any water left in the wallow, so that without rain this mudhole would soon be of no further value to the animals. At 11 a.m. and at 5 p.m. the author left the blind for a short time, but this did not stop a rhino from appearing once again at 7.45 p.m. in dry weather with little wind; this was probably the one with the pointed horn that had already visited the wallow that morning. There was hardly an opportunity to investigate where exactly the animal came from before he was already in the wallow. Soon the familiar snorting could be heard, and once again the rhino did not react in the slightest to the beams of the flashlight. His behaviour was as described above; the bull moved his head violently up and down in the muddy water, lay on his side, lifted the front part of his body out of the water several times, and banged the side of his head and also his horn against the edge of the "pangujangan". Although a soft "ceeh-ceeh" was several times uttered, the presence of a second specimen could not be established. At 10 p.m., i.e. after over two hours, the rhino left the wallow and began to rub himself against the first tree encountered, initially the front part of the body, then the hind leg, the body swinging lengthwise and the powerful musculature of the colossus being clearly visible. Large lumps of mud adhered to the trunk or fell to the ground; the bull then disappeared quite calmly into the night darkness of the forest.

Although the author remained almost uninterruptedly in the blind the next day he saw nothing of rhino, but shortly after midnight on that day a rhino appeared which was probably the same bull again. He came out of the jungle at 1.45 a.m., and soon lay in the wallow. However, unlike the previous observation, the animal gave a restless impression; his breathing was irregular and he reared up repeatedly, winding excitedly and listening uninterruptedly. And yet it was not until 3.45 a.m. that he rushed from the wallow and disappeared loudly blowing, into the jungle, after which he seemed to have "sunk into the earth". But probably it was this rhino that returned soon after this flight, though for a short time only, for he disappeared again snorting without having wallowed. Probably the author was not to blame for this state of alarm, since he was sitting right out of the wind and barely moved; perhaps—looking back—this alarm was connected with the fight which the author was to witness next day less than a kilometre away from this spot (see also pp. 99, 133).

The third time that a rhino cow was seen with a small calf was in the early evening of 13 February. Although both animals seemed smaller to the author than those observed in the nights of 2 and 3 January from his first observation post, it is assumed that these were the same specimens and that the bad light hampered identification.

Whilst it was not yet entirely dark, the snapping of thick branches betrayed the presence nearby of a rhino, and at 7.30 p.m. a small one appeared nearly underneath the blind, about 15 metres away from it. This animal was soon followed by a large

female. This time the wallow remained untouched, for the cow became alarmed and returned snorting to her track with the small calf on her heels; however, this happened without much haste and quite differently—in less panic—than when caused by human scent. The author therefore considers it probable that the two animals were driven away by a third rhino which appeared shortly afterwards, a bull with a short horn that appeared from the understorey. This animal followed a track which had been taken by no other rhino seen here, and headed at great speed for the "pangujangan". Since the bull, while in the wallow, despite repeated attempts, did not succeed once in turning on his back, he seemed to be a "stranger", also in view of the uncommon direction from which he came and the short horn. This rhino, too, repeatedly raised the front part of his body out of the water and sometimes rubbed his head on dry land, etc. But he left the wallow after only 10 minutes and rubbed himself against a thin tree up till then not used for that purpose by any other rhino; he then disappeared. Soon afterwards a great deal of cracking was heard in the jungle, culminating in a loud snap, doubtless caused by a tree being broken by this same animal.

Although in the evening of 14 February the snorting of a rhino was heard, none appeared in the vicinity of the blind, and the same applied to the next two nights; this was probably the result of the state of the two "pangujangan", which did not appeal greatly to rhino, as a result of the only slight rainfall. But at 6.30 p.m. on 17 February two rhino were heard. They were uttering short calls somewhat reminiscent of those of barking deer. They were probably operating a considerable distance apart, but the author did not see one before 8.15 p.m., when a bull rushed out of the understorey and soon afterwards was lying in the wallow, which now contained only little water. Soon after that a second bull appeared, which again behaved strangely, for he approached the "pangujangan" most cautiously and hesitantly with his nose to the ground. The noise made by the wallowing rhino apparently had a vicious sound to the second bull, since the latter seemed even more on the alert when he approached the pool, in which the other one had half reared up. Although up to then it had always been the case that a rhino coming from that path had entered the wallow without much ado, this was not so now, for the newcomer continued to walk around the mudhole at the same slow pace and with his nose pressed to the ground, and tried to enter the wallow stealthily behind the other's back. But when he was half in it, the "bather" turned round with a loud snort, whereupon the newcomer briefly withdrew, but continued to stand with lowered head. When, shortly afterwards, the other came on to dry land, the expected fight did not occur but the animals walked close behind one another in the direction of the author's blind. Now it was certainly human scent that caused the larger specimen, which had been lying in the mud, to become alarmed and to disappear towards the jungle in the opposite direction, running in part right through the wallow. The smaller one also departed, though following another track and in complete calm. The author later heard the cracking of branches or trees and some sniffing as well, but there was nothing more to be seen.

Despite this strange and apparently unfriendly behaviour, these were probably

the same animals as those observed in the early morning of 11 February. Since it was impossible to establish the simultaneous presence of more than two male rhino or one bull with the cow and calf on any single occasion, and perhaps another lonely female, it may be assumed that in these two periods of observation not more than three or perhaps four different bulls and two adult females, of which one was accompanied by a calf, were seen. The two males observed in January, the long-horn seen on 10 February and the short-horn observed on 13 February were probably different specimens, as was the female seen in the early morning of 5 January, although it is not quite sure that she was in fact a cow; she was smaller in size than the first one with her calf and quite alone. The calf was perhaps also a female because nothing at all could be seen of a horn on its head.

During the whole of this second period, the wallow in use in December/January was not visited any more at all by rhino, nor afterwards, as stated above. From 18 February this second "pangujangan" was apparently no longer in vogue either. Although heavy rain fell in the night of 18 February, which greatly improved the state of the two wallows, nothing more at all was noted of rhino, though about 7.15 a.m. on the following day the distant sound of such an animal was heard. The next night, too, considerable rain fell until far into the morning, exactly the type of weather that had previously been accompanied by a climax in rhino visits, but the author again waited in vain. In the night of 20 February he had no more success, and since nothing further had been seen of rhino in the vicinity for several days in succession, observations at this place were interrupted.

It is highly probable that four of the wallows found by the author in use on 18 and 19 February, which lay some kilometres away from these observation posts, were visited by the same rhino. In those days numerous feeding and walking marks were also observed in the adjoining coastal zone; this strengthened an earlier belief that the use of certain wallows is closely connected with the changing browsing areas. Since the author in those days witnessed contact between two rhino of opposite sex, at a locality quite close to these "pangujangan" (see also pp. 133-134), it may not be excluded that a female rhino in heat was one of the reasons of the long presence of various bulls.

The small number (two or three) of fresh dung heaps found despite this busy rhino traffic convinced the author that the number of individuals was small, as he has already suggested above on other grounds.

Rhino could be observed by day in different parts of Udjung Kulon in wallows or along muddy river banks. The animals encountered in the "pangujangan" never lay deeply immersed in these, since this was hardly ever possible owing to the limited depth of the wallows. But along river banks rhino were occasionally seen with only their heads protruding from the water. Such encounters have already been reported on earlier occasions (Hoogerwerf 1939^c, 1949).

It may be repeated here that according to reports received from the population living along the eastern boundary of the sanctuary in June 1956 a rhino was repeatedly seen wallowing with domesticated buffaloes on the territory of Tjika-wung village, somewhat to the east of the reserve. The reports do not say whether

this happened by day or by night; probably it was by day, since buffaloes usually do not visit such wallows at night. As far as Udjung Kulon is concerned, the author neither accepts the assertion of Sody (1959: 203)—on the basis of the experience of others—that wallowing takes place both in mudholes and clear water, nor the information of Schenkel (1967) that wallowing takes place in the sea.

Although rhino were several times encountered in a river which, in view of the nature of its bottom and the clear water, probably offered little opportunity for wallowing, it is of course not impossible that in those cases the animals were looking for such an opportunity there. On 8 October, 1941, a rhino was seen walking across more or less horizontal limestone terraces in the clear Tjigenter river, but not far from there were a number of localities suitable for wallowing. It is also possible that these animals come down to such rivers to drink or to rest. It occasionally happened too that rhino were engaged in crossing these rivers, so that wallowing did not enter into consideration. The observation to be discussed below (Chapter 16) of two rhino that were seen lying in the sea on a hard sandy beach early in the morning is one of the very few cases known to the author in which such animals lay in the water obviously without intending to wallow. Perhaps it happens more frequently, but the tracks found on the beach in the course of the years have never given any reason for assuming this.

As regards the purpose of wallowing, the author does not possess any certain information from his own experience, but the reasons mentioned by Sody on the grounds of the literature consulted by him seem acceptable. Probably it will be less a matter of cooling—since the wallows cannot always offer such cooling—than keeping the skin supple and protection against vermin which lead to the need for such baths.

Bruton (1963) writes: "Wallowing seems to serve the functions of cooling the animal, keeping the skin wet, and protecting the skin against the many parasites that attack the animal". Gee (1964) states with regard to *Rhinoceros unicornis* that it lies in mud by day as a protection against flies, which try to lay eggs in the folds of its skin. It is, however, the question whether these data are based on personal observations or on reports from others.

Schenkel (1969: 113) writes: "The functions of bathing and mud wallowing are manifold: Lying in water has an effect on the body temperature and on the skin condition. It protects the animal from ectoparasites, mainly biting *Diptera*. The layer of clay which covers the body after wallowing prolongates these protective effects. Urination in the wallow causes olfactory impregnation of the skin and thereby of the rhino's trail". And (1969: 132): "As in other rhino species, wallows and rivers are not only used for wallowing but also for resting."

Although it seems almost impossible to know whether a rhino when lying in a river or wallow, etc., is wallowing, bathing or simply resting, wallowing may be considered out of the question when the animal is found in water basins without mud.

Schenkel may be right in attributing a scent-marking function to the rhino's urination when wallowing.

As far as Udjung Kulon is concerned little can be said about the ectoparasites preying on these pachyderms and the vermin otherwise infesting them. The author

once picked up a large tick from the spot where a rhino had been lying on the ground a moment before; this proved to be a *Amblyomma crenatum* (see Kraneveld and Keidel (1956)). It is not impossible that rhino have considerable trouble with such vermin, as Sody (1959: 204) states on the authority of Wood and Andrasz, and as Hazewinkel (1933) also reports, but the author lacks data of his own, because he has been unable to examine a single rhino. Franck (1934), in giving the details of the rhino shot by him in South Garut, says nothing about ectoparasites.

Representatives of the genus *Amblyomma* were also found in the black rhinoceros besides quite a lot of other ticks, without the animals being seriously affected by these ectoparasites. This African rhino is also said to be susceptible to the bot fly, a parasite infecting the intestines and the stomach.

During his stay in the sanctuary Schenkel (1967) proved to be infested by ectoparasites, and he assumes that probably the rhino is one of the hosts of these parasites. The present author never had such an experience there, nor did he find any indications that any species of game living in Ujung Kulon suffered severely from such parasites. The two veterinary surgeons who examined a number of banteng, two deer and a muntjac expressed their surprise at the small number of ectoparasites found.

Sometimes nothing was seen of bloodsuckers in the wallows frequented by rhino, but it also occasionally happened that large numbers of these appeared on the surface of the turbid water when this was stirred with a twig. It may be considered probable that they do not leave the rhino alone.

Nor does the author know anything about the composition of the water of these "pangujangan". A number of water and mud samples collected were lost during the war years in the laboratory and after the war there was no opportunity for such research. Most of the wallows seen by the author were in yellowish-brown marly soil, and the bathing places in banks of rivers and creeks were often in mangrove mud. The fact that the rhino also sometimes wallow in salt and brackish water, among other places in the tidal rivers and creeks, whose water and mud may be assumed to be of a different chemical composition from that of the "pangujangan" further inland, indicates that this composition is not of vital importance.

Strickland (1967) found an increasing activity in the *Dicerorhinus sumatrensis* studied in the Sungei Dusun Game Reserve (Malaya) by baiting wallows with salt, although their visits to the wallows still appeared sporadic.

The wallows in Ujung Kulon are visited not only by rhino but also by wild boar, monitor lizards and, sporadically, by stags, but they hardly ever get further than the edge. Only now and again was a monitor lizard seen in them by day during the same period in which rhino were visiting them at night, evidently in search of food, perhaps nematodes, insect larvae, etc.

Above details are given of the "reach" of the rhino, the height of the pushing and feeding marks in browsing and the rubbing marks formed by mud after wallowing being discussed. The greatest heights at which such rubbing marks were found were 215, 222, 230, 247 and 267 cm, which correspond almost exactly to those measured with the first category, relating to browsing marks.

CHAPTER 16

REPRODUCTION

COMPOSITION OF THE POPULATION

A thorough knowledge of the composition of the rhino population as far as the different age classes and the sex ratio are concerned is of paramount importance. From the measured footprints, the following synopsis was compiled showing the frequency in which adult rhino (width of fore print exceeding 25 cm) belonging to different age classes were tracked. Only those cases of which the exact measurements could be established are included. Because the measurements were taken at random during many years, the figures do not relate to as many different individuals, though they might present a reliable average picture of the real situation during the period of the author's investigations.

On pp. 142 and 144 a survey is produced of the measured footmarks of rhino, which, in the author's opinion, were not yet adult; they have been left out of consideration in the present table.

In the following synopsis the figures above the line are the width in centimetres and those below the line the number of measurements (25-27 means exceeding 25 to 27 cm inclusive, etc.).

fore foot	$\frac{25-27}{32}$	$\frac{27-28.5}{130}$	$\frac{28.5-29.5}{38}$	$\frac{29.5-31.5}{27}$	$\frac{31.5-32}{4}$
hind foot	$\frac{23.5-24.5}{9}$	$\frac{24.5-26.5}{65}$	$\frac{26.5-28.5}{44}$		
width of fore hoof	$\frac{\text{less than 11}}{20}$	$\frac{11-11.5}{59}$	$\frac{12}{59}$	$\frac{12.5}{\text{not measured}}$	$\frac{13}{14}$ $\frac{14}{7}$ $\frac{15}{2}$
width of hind hoof	$\frac{\text{less than 11}}{20}$	$\frac{11-11.5}{34}$	$\frac{12}{11}$	$\frac{12.5}{3}$	

These figures might indicate that a vast majority of the rhino belong to an age group which is most probably very suitable for reproduction. The animals producing footmarks wider than 30.5 cm and having a fore hoof wider than 14 cm (measured only 12 and 2 times respectively) probably represent a small group of very old individuals. The situation would have been worse in the case of a domination of the figures relating to animals belonging to the latter group, formed by rhino which had lived here already perhaps for 30 or 40 years. There is apparently no question of a preponderance of such old individuals: the present stock may be considered a vital one, well suitable for sound propagation.

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The figures included in the table do not differentiate between footmarks of male and female rhino, but the sex ratio problem will be discussed at length below.

One is inclined to consider the situation as not so bad, but the small numbers of non-adult animals observed in the course of the investigation period (pp. 138-146) form an indication that the number of breeding pairs was always small.

When comparing these figures with those given by Schenkel (1969: 129) the percentage of very old individuals (category V of Schenkel's table) is considerably higher than the percentage found by the author, whilst Schenkel's number of specimens below the age of two years (8-9 in 1967 and 5-6 in 1968) is extremely high compared with the author's table of semi-adult rhino during a period of 14 years (p. 144).

SEX RATIO

No absolutely exact particulars are available, but there are indications of an unbalanced sex ratio in favour of the bulls.

In 1940-1944 the guards encountered a male (♂) 78 times and a female (♀) only 22 times (during 1941, 1943 and the first four months of 1944 they recorded 51 ♂ and only 9 ♀); in 1951-1956 they encountered a ♂ on 43 occasions and a ♀ 36 times. In 1937-1942 the author saw a ♂ 22 times and a ♀ only 8 times, and from 1952-1954 a ♂ 8 times and a ♀ twice. In other words, in those years a male rhino was seen 151 times and a female 68 times, so that one can definitely not speak of a 1:1 ratio. The number of encounters with rhino was considerably greater than finds expression above, but not all the monthly reports are available and in many cases relating to the author's experiences the sex could not be determined for sure. The author's observations of the footprints, which are supposed to show sexual dimorphism, also brought him as early as 1937 to the conclusion expressed above, a conclusion that did not call for revision during any survey made thereafter. The difference in sex ratio was usually much more striking than in the total figure given above, and probably this ratio is considerably more unfavourable than may be deduced from the above recapitulation.

It does not seem realistic to ascribe this situation to the shooting of more females than males, since the data available do not point in such a direction at all. In fact, precisely the opposite was the case: 70-80% of the rhino killed were bulls; it is almost certain that this has never been otherwise, since males always represent a greater value than females through their possession of the most valuable part of the body—the horn.

The author has no data on the sex ratio of *Rhinoceros unicornis* except those from the Basle Zoo where out of the 9 young born there, 6 are males. Gee (1953) states with regard to this species in the Kaziranga reserve (Assam) that all the very old specimens which he observed were males, but he does not draw any conclusion from these observations as far as the sex ratio is concerned. It does not seem very probable that an on average greater age of the bulls in Ujung Kulon—assuming that this exists—would have led to the difference in sex ratio suggested above, since the situation as pictured there is based on particulars collected on all age

classes. Talbot writes in the report previously mentioned that both sexes occur in Ujung Kulon in equal numbers; since he does not support this very important assertion by the slightest argument, discussion is out of the question.

The same holds good for the 1:1 sex ratio based by Schenkel (1969: 130) on his experience with the black rhinoceros within three different areas in Africa. Also when considering the number of immatures in Ujung Kulon he thinks it justified to accept such a sex ratio.

During 1967 and 1968 Schenkel and the guards did not see a single hornless rhino except three immature individuals, which made him conclude that among the observed animals with a horn "clearly some were females". The author's objections against this conception are given on pp. 76-77. The statements of Schenkel confirm the author's opinion that in Ujung Kulon female rhino are much rarer than bulls and that a sex ratio of 1:1 must be strongly doubted.

It is highly improbable that the unsatisfactory state of affairs as suggested above could be ascribed to certain shortcomings of the habitat (Chapters 2 and 14). Ujung Kulon is not an area which has artificially been made the habitat of *Rhinoceros sondaicus*; it is the last remnant of a much greater natural range. The large number of rhino killed inside this sanctuary during the last half-century is proof enough that there is room here for a much larger stock than still lives or recently lived there.

More knowledge about the present sex ratio is needed, as is evident from a recent paper of Erna Mohr (1968) on *Rucervus schomburgki* in which it is suggested that a surplus of males in a species may stimulate its dying out. With regard to this it is said: "Wie bei anderen im Bestand gefährdeten Tierarten (Mohr 1967, p. 71) wurde auch beim Schomburgk-Hirsch das Erlöschen der Art durch Männchenbrütigkeit vorbereitet und gefördert. Von den nach Europa gebrachten lebenden Tieren waren 3 ♂♂ und 2 ♀♀, unter den in Hamburger Zoo gesetzten nachgewiesenen 11 Kälbern 8 ♂♂ und nur 3 ♀♀, von denen auch noch 2 ♀♀ (und 1 ♂) tot geboren wurden. Bei solchen Zahlen liesz sich das Erlöschen der Art selbst durch die beträchtliche Langlebigkeit von 16-18 Jahren nur hinauszögern, aber nicht verhindern".*)

RHINO ENCOUNTERED IN PAIRS

A discussion of this subject must of course be preceded by a consideration of the cases in which more than one rhino was seen at the same time or there were obvious signs that this had been so; something has already been said about this in Chapters 13 and 15. Adult females accompanied by young are discussed separately below.

Besides the author's personal observations, use will also be made here of daily reports of the guards, though only over a period in which their patrols were checked by using watchman's clocks.

* Although Dr. C. P. Groves (in litt.) does not venture a definite opinion, he considers it possible that the rhino population in Ujung Kulon may be so highly inbred by now that many quite atypical genes may dominate with as its consequence a preponderance of bulls.

There are no reliable data on the period 1945 to the end of 1950, since during the last part of the Japanese occupation until after the transfer of sovereignty Ujung Kulon was hardly administered, if at all.

From 1937 to 1944 and from the end of 1950 to the end of 1956 two adult rhino of opposite sex were seen or tracked together 35 times in all; on three occasions they were accompanied by a small calf and once by a big one. In addition two bulls and one cow were observed twice, two males six times and three rhino three times, among which there was a semi-adult specimen besides what was probably an adult pair.

Of these 46 encounters, 15 of them involved the author personally, only three being based on visual observation. However, excepted from this are the series of observations in and around the wallows in December 1940 and January/February 1941 (Chapter 15).

The cases reported by the guards were without exception visual records and were accompanied by exact indications of place and time.

The observations made from spoor, to which most of the facts established by the author relate, were so evident that the accuracy of sex determination need not be doubted.

Rhino running in pairs were determined in every month except April (in that month the author barely visited the reserve), viz. in January: 1941 and 1956; February: 1941 (twice); March: 1955 (twice); May: 1941 (four times), 1951 and 1955; June: 1943 (twice), 1950 and 1955 (together with a small calf); July: 1941 (together with a small calf) and 1943; August: 1943 (twice) and 1955 (twice; once with a small calf); September: 1937 (twice; once with a large calf), 1952 and 1953; October: 1938, 1939, 1943 and 1954; November: 1955 (twice) and December: 1940 (twice) and 1955.

Two adult bulls were established as running together in July: 1940; September: 1943; October: 1943 (three times) and November: 1951. We have read in Chapter 15 that in December 1940 and January/February 1941 two bulls were seen together in a wallow on a number of occasions. According to the author's notes, a striking number of double tracks were seen in September 1953, probably mainly made by individuals running in pairs, without it being possible to determine to how many pairs these tracks related.

Two adult bulls together with an adult female could be determined in September 1943 and October 1943 and finally three rhino were seen together and tracked in February, March and December 1955. In the December case there were probably two females of which one was semi-adult and in March one of the two bulls was very probably an immature specimen. These animals were tracked along the south coast beach on 1 and 3 March (Plate 32); they were probably the same animals which had been seen at the same place by some guards on the previous 23 February. They saw two bulls and one cow and in all these cases it was probably a cow accompanied by a large calf which had been joined by an adult bull. According to the guards, one of the bulls had attempted to mate.

In those cases in which the observations of individuals running in pairs were

made with only a few days' difference in the same month of the same year, often in the same vicinity, it is highly probable that in some of the cases the same animals were concerned (three of the four in May 1941, the two in August 1943 and the two cases found in November 1955), because they were established in the same region. For the same reason this was presumably also true of the two male and the adult female rhino which were seen in September and October 1943 and the two males seen along the south coast on 23 and 26 October of that same year.

As no indication could be obtained of the length of the period during which rhino continue to run in pairs, it is not impossible that the couples seen in February and May 1941 were also in part the same; this may also have been so with the rhino observed in March, May and June 1955, and those of June, July, August and October 1943, all encountered in the south coast area. In view of the fact that Gee (1952^a) found with *Rhinoceros unicornis* that this period may be five months, the possibilities put forward above must certainly be taken into account.

Schenkel's assertions (1969: 121, 133) that "there was no indication that an adult male and a female stood together for any length of time; the pair bond is obviously not stable", and: "... the association of bull and cow is certainly for short duration" are not supported by sufficient evidence.

On the strength of the above the number of *different* pairs of rhino might even be much smaller than the figures just given, would suggest, which are low enough as they are, and which was acquired over a large number of years during which very intensive attention was devoted to this subject.

Nor is it entirely out of the question that in the cases noted by the guards of rhino associating together one of the partners was not yet entirely adult. As previously stated, when the author measured tracks, he took as adult rhino with a fore foot wider than 25 cm; differences in sex were assessed on the shape of the nail on the fore toes (the fore hoof), which is supposed to be more curved on an adult bull than it is with a cow (p. 84).

The incompletely available reports of the guards and the author's naturally only periodical visits to the reserve do not make it possible to give a complete picture. But it seems realistic to draw a conclusion by means of a comparison of the observations of more than one rhino at the same time with those of solitary animals. From the figures given on p. 128, it emerges that during the period of the author's investigations rhino whose sex could be determined were *seen* 219 times; in at least as large a number of cases such animals were seen or heard in the thick undergrowth or in other difficult conditions without it being possible to establish the sex by means of visual observation or by the spoor although almost without exception it was possible to establish whether the animals were alone or not. The total of these visual and aural observations is only a fraction of the number of prints measured. During the author's first survey through the reserve in 1937, lasting about six weeks, no less than 500 rhino tracks were measured. It must be regarded as disquieting that out of such a large number of observations, plus the many visual records of the guards, rhino running in pairs and specimens accompanied by small or semi-adult young (a list of which will be given below) could be established with certainty in such a few cases only.

Schenkel's communications on this point are extremely scarce. He (1969: 121) writes: "Once we came upon the fresh footprints of two adult individuals which had followed one another to the beach. On a few other occasions we found the traces of an animal which had urinated frequently backwards-upwards onto the vegetation, presumably a bull, while following the trail of another rhino." The fact that he records hardly any other observation relating to propagation and he probably did not see a single adult female demonstrates today's extremely poor situation.

PHENOMENA PROBABLY CONNECTED WITH RUT

In encounters with rhino going in pairs, an attack or what was fancied to be an attack on the human observers was made on five different occasions, three times by a cow, twice by a bull (Chapter 13). In one of these cases (12 October, 1939), the cow was injured, the same being observed on 27 May, 1941, with a female, accompanied by a bull, that was lying in the sea between the Tjigenter and the Tjihanduleum rivers. At 5 a.m. on that day the guards living on one of the Handuleum Islands heard a tremendous roar that certainly came from these two animals, which were shortly afterwards seen in the sea off a beach about 1,500 metres away from the bivouac on those islands. That this uproar could be heard so far away may give an impression of the volume of that sound.

In a small proa the guards were able, with a favourable wind, to approach within about thirty metres of the cow. They noted a severe wound on her hindquarters. The guards supposed that this wound had been caused by a tiger and that the bull, which had meanwhile returned to dry land, was trying to protect the cow against further attacks. The author was able to visit the spot a few hours after this incident and could reconstruct the events fairly accurately by means of the tracks. Nothing could be seen of the presence of a tiger. In the coastal vegetation clear signs were found at different places pointing to skirmishes or fights as already encountered by the author over three months before at two quite different places (see below). These were probably also the two rhino who attacked each other amidst heavy jungle in the afternoon of the same day, a few hundred metres away from that spot, again accompanied by a tremendous roaring. The tracks relating to this fight could not, unfortunately, be examined, since there was no time that afternoon and the author had to leave early next morning to answer an urgent summons by the army commander.

Over 15 years later, in the afternoon of 24 August, 1956, the last day spent in Udjung Kulon, the same frightening roar was heard that had accompanied contact between rhino of opposite sex in the two cases in May 1941, perhaps also pointing to such a contact. This was at the exact locality where the same hubbub had been heard on 27 May, 1941. In this case, too, shortage of time, very bad weather and the extremely difficult terrain hampered close investigation of the tracks of this last encounter of which the author was a witness.

In both these cases roaring was repeatedly heard as the rhino moved further and further away from the first point and apparently kept on changing the scene of combat.

The following may be added to what was said on p. 99 about the skirmishing observed on 14 February, 1941, between two rhino, of which the cow was definitely not injured. It was impossible definitely to establish that on both these occasions (14 February and 27 May, 1941) and in the case of 16 February of that year, which will be discussed below, the same couple of rhino were concerned; however, this may have been so (see p. 131, referring to the experiences of Gee, 1952^a).

On 14 February, 1941, in the midst of dense scrub jungle, mainly consisting of almost monotypic stands of *Ardisia humilis* and *Acrostichum aureum*, two rhino of opposite sex faced each other, about two metres away, with lowered heads. Once the bull launched an attack on the cow from such a position, accompanied by loud sniffing and the above-mentioned roar, whereby the bull raised his head a little. The female stood there motionless, but seemed to brace herself; there was no contact, for just before he would have struck the cow the bull stopped, stood still for a moment and rushed away. The cow did the same shortly afterwards, but did not go anything like as far away; the bull returned to that spot within a few short minutes and again the animals faced up to one another. This process was repeated several times at widely separated places. It was evident from the uproar that was again heard that the bull was preparing or had started a new assault.

Almost immediately after the cow involved in this skirmishing had made the attack on the author described on p. 99, she again caught up with the bull barely 100 metres away from the place where she had charged; apparently this bull had noted nothing of the author's presence.

The great destruction found at various places after this and the other cases of skirmishing mentioned above makes it clear that such sparring does not always proceed so calmly, but sometimes does in fact lead to serious combat. Unlike what happened in the sham fight described above, thick branches are torn off, small trees uprooted and the ground ploughed up, as the author was able to see for himself at other places that day and on some later occasions.

In the morning of 16 February, 1941, i.e. two days after the encounter just described at which the author was personally present, some of the guards living on Pulau Peutjang told him that they had been startled at night by the roars of rhino. When the author investigated next morning along the beach lying opposite that island, 800 to 1000 metres away from it, he was able to reconstruct the events of that night with a fair degree of accuracy. They seemed analogous to the events of nearly two days before, which had taken place in the Niur area. On the high beach, just along a belt of shrublike vegetation, numerous tracks were found over a distance of about 200 metres of two rhino which had been in contact with one another at four different places. The sand was churned up, and driftwood had been trampled and scattered. The tracks seemed to indicate animals of a different sex, but it could not be established whether these were the same specimens of two days before.

The distance between the localities where this series of observations in February 1941 was made was about 12 km.

Besides the three cases mentioned above (14 February and 27 May, 1941, and

24 August, 1956), this roar was heard by the author himself on 10 February, 1941 (pp. 121-122) when observing wallowing rhino, quite close to the place where, four days later, the fight was witnessed; on 29 September, 1942, in the forest near Tdj. Alang-alang and in the evening of 3 October, 1942, in the area opposite Pulau Peutjang. In both the latter cases it was repeated four or five times, creating the impression that the animals were moving about, just as in the other encounters. These were again observations made shortly after one another, this time about 15 km apart.

If this loud roaring (see description on pp. 79-81) is one of the actions preceding mating—as the author believes—then the limited number of occasions on which it has been heard during such a long period of investigations reinforces the pronouncement made above with regard to the rare occurrence of rhino in pairs. This sad situation would be further accentuated if *Rhinoceros sondaicus* were polyoestrous, as is said to be the case in all rhino species which have been studied.

These and a number of other observations indicate that during such fights or skirmishes, when taking place at short intervals, the rhino move over short distances only. They are probably the climax to a lengthy pursuit of the cow by the bull—also presumed by Lang (1961) on the strength of his observations of *Rhinoceros unicornis* living in captivity—and the harbinger of a more peaceful coexistence from which mating finally results. The head-on position in a caressing mannerism, as stated for a pair of *Rhinoceros unicornis* observed in a wild state (Gee 1953), need not be considered impossible for *Rhinoceros sondaicus* in the final stage of such encounters, which the present author perhaps never witnessed. In the incident observed in Ujung Kulon on 14 February, 1941, there was no question of a caress, as was apparently the case with the rhinos observed by Gee, which finally stood peacefully nose to nose. And also the quiet behaviour which Gee describes as having followed mating is completely at variance with what the author saw after those contacts in Ujung Kulon: the animals appeared extremely nervous and to be under terrific strain. Consequently the present author does not believe in mating at the stage of these fights. Perhaps mating might in fact have occurred on 28 June, 1950, when staff working along Muara Tjikuja were driven out of their encampment for the night by two rhino. These men spoke of mating, not fighting rhino, which are quite different things to those people too. The observation by some of the guards along the south coast on 23 February, 1955 (p. 130) also points to an attempt at mating.

It is quite understandable that in fights such as those described above injuries can be suffered, though this is perhaps not a regular phenomenon. As stated previously, the female that attacked on 12 October, 1939, had been injured in the shoulder according to those who witnessed the attack, and the specimen lying in the sea on 27 May, 1941, which, as in the first case, was in the company of a bull, had a large wound in the hindquarters.

The author's experiences in the sanctuary are almost the same as those of Guggisberg (1966) with the African black rhinoceros: "Most of the fights I have seen were between males and females and had a direct sexual significance. On several

occasions I have seen a bull and a cow pushing each other around, sometimes, as has already been described, throwing up clouds of dust with their hind legs. All this fitted in very well with what T. A. Ritchie had to say in an excellent paper based on thirty years' experience with rhino: 'Mating is almost always preceded and usually succeeded by violent attacks on the bull by the cow'. Guggisberg also describes such a fight accompanied by a "loud snarling sound": "It was an utterly fantastic spectacle—a breathtaking scene of life in primeval times, when gigantic beasts ruled the world and man was nothing but a chattering ape! After four or five minutes the cow broke away and tore through the bushes at a mad gallop, the bull following in hot pursuit. He caught up with her after a chase of about a third of a mile, and the fight started all over again." And later: "I could not see any blood on the female, but I certainly realized why rhino were always covered with scars and open sores!"

This almost completely covers what was witnessed in Ujung Kulon; apparently this hostile attitude finally leads to the more friendly behaviour as pictured by Gee just before or after mating takes place, as is the case with many other animals, including birds.

In the Basle Zoo a bull of the species *Rhinoceros unicornis* injured the cow during the rutting season, while the bull very often chased violently after the cow, so that the animals had sometimes to be separated (Lang 1961). The pursuits were usually of a very fierce nature, as is clearly illustrated by a photograph taken in that zoo on 18 December, 1958. In the course of such a pursuit the cow was hurled by the bull into the moat of the open-air enclosure, fortunately without serious injury. On another occasion—though this time the cow was *not* in heat—the latter saw no other way out during a very exciting pursuit by the bull than to jump into the moat! In the Calcutta Zoo, too, a pair of the same species had to be kept separate on account of inimical behaviour. Great caution was also observed in the Sydney Zoo in April 1963—when the present author was visiting that zoo—where a bull of the African black rhino (*Diceros bicornis*) was admitted daily for a short time under strict surveillance to a cow in heat. Both animals adopted a highly inimical attitude towards one another and had suffered head injuries during clashes which had occurred earlier in that period. The cow was at that time particularly aggressive towards the zoo staff, but she appeared frightened of the bull and periodically trotted round, apparently in the grip of panic.

Although it seems logical to assume that it is the bull who pursues the cow, Lang (1961) reports that it was a fairly regular occurrence for the cow to chase the bull. This agrees with Gee's (1964) opinion that if two rhino chase after each other they are not usually two bulls, but a female in season behind a reluctant bull.

Fights between animals of the same sex, as supposed by Gee, need in no way be considered out of the question. Some of the *Rhinoceros unicornis* seen by him in nature were injured or had scars, such as damaged ears. Elsewhere in the literature on African rhino mention is likewise made of badly injured ears and even of animals with their ears bitten right off, but such injuries can of course also have been caused by fights with individuals of the opposite sex and with animals of

other species. The author has been unable to collect a single piece of information on fights between rhino of the same sex in Ujung Kulon, which is rather surprising considering the supposed surplus of male rhino established.

PERIOD OF RUT AND THE PROBLEM OF A SEPARATE RUT IN BULL AND COW

Since individuals running in pairs in Ujung Kulon could be determined in about the same degree almost every month, although this rhino is quite clearly a solitary species, the author cannot suggest specific times for mating and calving. This, too, would tally more or less with what Gee stated for *Rhinoceros unicornis*, whereby mating in nature was established or strongly presumed in January to August inclusive. Gee (1964) likewise states that the rhino cow comes into heat every 46-48 days throughout the year, unless she is served by a bull. This agrees with what is said about the Basle cow with a rutting period occurring every 36-58 days (on average 44) and usually lasting only 24 hours. Over a period of two years a cow of *Rhinoceros unicornis* at Whipsnade Park came into oestrus with intervals of 41 to 78, once even of 126 days, and oestrus also did not last longer than 24 hours only (Tong 1960). This so frequent rut might suggest a monogamous way of life, as is said to be the case with one of the two species of African rhino. But a monogamous way of life among *Rhinoceros sondaicus* seems most improbable.

The fact that, despite a regularly and fairly often occurring rut—assuming that this is also the case with the Javan rhino—so little was seen of rhino going about in pairs in Ujung Kulon is probably another strong indication of the presence of too small a number of individuals. The disadvantage of a short rut will increase according as the number of rhino decreases, since as a result successful encounters between adult animals of the opposite sex will become more and more difficult. However, in this case the rather small area of the present sanctuary may reduce this drawback somewhat.

In the Basle Zoo a heat of the cow was followed in almost all cases by mating (Lang 1961), but these were rhino living in very close contact with each other in captivity. Among wild animals such contact is doubtless much less intensive and will be greatly influenced by extent and character of the range and the number of individuals available, as also presumed by Krumbiegel (1960).

The situation with a small number of rhino would be even more unfavourable if heat in the cow does not coincide with a corresponding season in the bull. Gee (1953) writes the following about this: "The present pair in the Alipore Zoological Gardens, Calcutta, have not successfully mated. It is the opinion of the Superintendent, who has been observing them for the last seven years, that they 'were never observed to come in heat simultaneously, i.e. the female comes to heat when the male is not in rut and vice versa'. This view seems to be shared by Dr. Dillon Ripley of the U.S.A., who believes that the male rhino undergoes a period of sexual excitement as well as the female, and that the periods must be coincidental before mating can be attempted or accomplished. No such period, however, has been observed in the male at the Chicago Zoological Park; and the Assistant



After the first bull had left (Plate 25), the second one crept back into the mud and retired about a quarter of an hour later. The shallowness of the wallow is evident



An hour later it was perhaps one of these rhino that returned, crossing the author's track of barely fifteen minutes before



An exposed wallow in the outskirts of the *Pandanus* belt along the south coast



Heavily damaged and deformed rubbing tree near a wallow

Director there informs me that a 'heat' period has only once been detected in the female—on September 9, 1949—which lasted mildly for three days. The male and female at this zoo have to be kept separate, for on the three occasions on which they have been put together there has been a fight. If the Chicago Zoo authorities had hardened their hearts and persevered with the matter, their two rhino might have become reconciled to each other, as in the recent case of the pair of the Basle Zoo".

The experience gained in the Basle Zoo and at Whipsnade Park for many years with *Rhinoceros unicornis* regarding a so frequent period of oestrus in the cow, which usually lasted only 24 hours, is at variance with what Ripley (1952) states with regard to this same species. Without giving further details he writes: "From observations in captivity an unmated female will come into heat about once a year, and similarly a bull rhino will have an annual breeding or 'rut' cycle. The length of this breeding cycle is uncertain but in captive animals it is only of a few days duration". About a couple of *Rhinoceros unicornis* living in Whipsnade Park it is said that the male appeared indifferent to the frequent periods of oestrus (see above) in the female, but seemed to have his own period of oestrus or heat two days later (Tong 1960). More or less at variance with this is the experience with *Rhinoceros unicornis* in the Basle Zoo, regarding which Dr. Wackernagel (in litt.) writes: "We have never observed any rut in our male rhinos, independent of the females' heat."

It is not clear whether the later communications by Gee (1964) on this important aspect are based on reliable field observations when he voices the supposition that the male animals likewise display rutting phenomena and that rutting must occur simultaneously with the two sexes before mating can take place. Data obtained from free-living rhino on this subject are so important because the frequency in which contact is sought between individuals of opposite sex is doubled if both sexes undergo a more or less regular rutting period, independent of each other.

About an African black rhinoceros, living in 1954 in the zoo of Rio de Janeiro, Guggisberg (1966) writes: "The authorities of the Rio Zoo made the interesting observation that up to three days before the birth, the female was being mounted at regular intervals. It must thus be assumed that the sexual cycle—in the case of the black rhino probably a cycle of three and a half weeks—goes on for the whole duration of the pregnancy. I must repeat that all this is based on observations in captivity. We do not yet know to what degree all this applies to rhino living under natural conditions."

PERIOD OF GESTATION AND OF CALVING

With regard to the period of gestation nothing is known about the Javan rhino, and reports on *Rhinoceros unicornis* vary quite considerably. By means of a birth in the Calcutta Zoo in 1925 Gee (1953) estimates the period of gestation at 19 months, a length of time which is also mentioned by Ripley (1952), and, according to Sody (1959: 198), Hodgson mentioned 17-18 months. However, a considerably shorter

period of gestation was found with thirteen young born in the Basle Zoo, viz. 462 to 489, on average 478, days, i.e. about 16 months (U Tun Yin in litt.) and with a calf born in Whipsnade Park, viz. 488 days (Tong 1960).

From the fact that in the Basle Zoo mating in a three-year-old rhino occurred in a normal way, as did gestation and calving, and a normal calf was born which was later sent to the Paris Zoo, it may be concluded that this may not be regarded as out of the question at all in nature. Although it took some considerable time in that zoo before young were born of fully adult animals, viz. from July 1952 to September 1956, from the latter date up to and including 1964 four were born of one pair of parents (1956, 1958, 1962, 1964) and in addition one (1963) of a specimen which was three years old when it became pregnant. In 1965 and 1967 three more rhino calves were born in that zoo.

Only two months after a birth in Basle on 17 August, 1958, the cow again came into oestrus, but the mating that followed had no result, any more than matings found to have taken place in 1958-1960. It was not until April 1961 that conception again occurred, the third calf being born on 31 August, 1962. Scarcely six months after this birth the young animal born on 17 August, 1958, gave birth (on 9 March, 1963) to a healthy calf, and it must therefore have become pregnant at the age of about 3 years 3 months. The fact that this three-year-old animal might not have reached full maturity could be derived from the fact that the withers of another female already considered adult in July 1952 increased in height in the period 1954-1960 from 152 to 160 cm.

A female rhino of the same species in Whipsnade Park came into oestrus for the first time at the age of approximately 4½ years (Tong 1960).

As far as Ujung Kulon is concerned there are no indications of female rhino of 3-4 years old going with young. The author never tracked a cow accompanied by a calf displaying a footprint below 28 cm; this size of 28 cm probably is too large for individuals below the age of four.

On the strength of the few cases of small calves being observed in Ujung Kulon or their presence being otherwise established it is difficult to say anything positive about the time when young are born in this area. The number of observations was too small for this, and the age of these calves was not exactly known.

OBSERVATIONS OF YOUNG CALVES

The number of observations made of juvenile or semi-adult specimens inside the sanctuary tallies with the relatively small number of times in which rhino running in pairs were established.

If then first of all remarks are devoted to young rhino under the age of one year, little more can be written from the author's personal experience than has already been done in Chapter 15 and on pp. 129-131. On 2 and 3 January and 13 February, 1941, such a calf was seen, and these were the only occasions on which the author was so fortunate. The footprint of this calf, when measured on 3 January, was just over 16 cm wide and the fore hoof had a width of approx. 8 cm;

from this, and from the estimated length and height of the body (60-70 cm), an age of not more than three months was concluded.

Not until September 1967 did it become possible to compare this size with footprints of a new-born female calf of *Rhinoceros unicornis*, most kindly measured for the author by the scientific assistant of the Basle Zoo, Dr. H. Wackernagel. The results of his measurements are given below.

Footprint measurements (in cm) of a female calf of *Rhinoceros unicornis* born in the Basle Zoo

age	width of fore foot	width of hind foot	width of fore hoof
1 month	12.0-12.5	12.0-12.5	6.5- 7.5
2 months	14.0-14.5	13.5-14.0	6.5- 7.5
3 months	16.0		7.5- 8.0
4 months	16.5-17.0		8.5
5 months	18.0-21.0		9.0-10.0
6 months	20.0		9.0-10.5

From these figures the rapid growth of the animal's feet during the first six months of life may be derived. Considering these measurements it seems safe to say that the age of the calf observed by the author in January and February 1941 was about three months when seen for the first time, which does not differ from the then estimated age. It is also justifiable to suppose that some (very rare) footprints of 20-22 cm measured by the author related to animals perhaps not yet a year old (see also p. 142).

For new-born calves of *Rhinoceros unicornis* in the Basle Zoo a shoulder height of 62 and 64 cm was measured, while Gee mentions sizes of 56-61 cm, the last height measured on a calf that was presumably trampled to death by the mother soon after birth. The calves born in Basle had a weight of 59 to 78 kg (5 males) and 67 to 70.5 kg (3 females).

Only most rarely were such narrow footprints as 16-18 cm measured by the author, viz. on 18 February, 1941, 16 August, 1941, and 26 November, 1954. On 19 April, 1941, a calf was seen by one of the guards, the age being estimated at six months. On 15 July, 1941, a reliable Indonesian tracker who often accompanied the author saw two adult rhino of opposite sex with a small calf along the beach near the mouth of the Tjitjangkok (north coast), only a few kilometres away from the place where the small calf had been seen six months before near the wallows (pp. 119-120, 122-123). It seems justified to suppose that the six observations of 1941 mentioned above refer to two different individuals, viz. one calf tracked and seen on 18 February and 19 April (almost certainly the calf seen by the author on 3 January and 13 February, 1941) and a second one tracked and seen on 15 July and 16 August of that same year.

An entirely different specimen was a calf tracked along the south coast together with the mother on 28 February, 1952. The fore print of this young animal could not be accurately established (17-20 cm), but the width of the fore hoof was only

7-8 cm. A fourth observation was made almost three years later. A series of visual and spoor observations from about 14 September, 1954, to August 1956 most probably related in their entirety to the same mother and child. They were made almost without exception from the Karang Randjang guard bivouac along the south coast of the sanctuary; on a number of occasions the animals were also seen or tracked 15-18 km away from this place, but almost without exception along the south coast or its neighbourhood. When this calf together with the cow was seen for the first time in mid September 1954, it was estimated by one of the guards as having the size of a wild boar, which thus points to a very small calf. On five separate occasions in November the pair were again seen at the same place. On 26 November the two animals were tracked by the author in the forest near the mouth of the Tjibunar, about 18 km west of Karang Randjang (see above). The width of the fore foot was 18 cm, that of the fore hoof 7-8 cm. In December they were twice seen at Karang Randjang, and now the calf was estimated at four months of age. Further observations took place in January 1955 (once), February (once) and July (four times), twice at the spot mentioned above and twice elsewhere along the south coast, the furthest point being about 12 km west of Karang Randjang. On 20 July the height at the shoulders was estimated at 100 cm and the length of the horn, which had meanwhile developed, at 5-7 cm. The next observations took place in August (three times), October (twice), November 1955 (twice) and January 1956 (once), six of these being at Karang Randjang and two a few kilometres west of that bivouac. On 16 August, 1956, the author tracked the two animals along the south coast near the Tjitadahan, about 15 km west of Karang Randjang (Plate 32). The greatest width of the fore foot then noted was 23 cm (in soft sand).

Very probably all the above observations between September 1954 and August 1956 related to the same animals, among other things because almost all the visual observations were made at the same locality and the tracks were usually not so far away from this place. The size and age estimates by the guards indicate that this was a very young calf which in November 1954, when it was perhaps five months old (three months after it had been seen for the first time, at the age of approximately two months), had a front foot width of 18 cm.

On 8 June, 1955, one of the guards observed an adult male and female, the latter accompanied by a small calf, near the Tjitjukanggalih, a few kilometres north of the mouth of the Tjibunar, which is about 18 km from Karang Randjang; this calf was estimated at about three months. Since no observations are known for that month with regard to the south coast, it is not impossible that in this case, too, the same individuals were concerned and the age of the calf was estimated too low. Perhaps it was also the same pair of rhino with calf, estimated by a guard at 10 months, that were observed on 8 August, 1955, along the south coast beach near the Tjitadahan, but it is not impossible that two different calves were involved. These observations of rhino running in pairs, the cow being accompanied by a small calf, are more or less in agreement with those made on 15 July, 1941 (p. 139), when a couple of adult rhino were seen, accompanied by such a calf. Since these are of course two entirely separate observations, it seems worth while pointing

explicitly to the analogy of them: a couple of adult rhino with a *small* calf.

These observations might indicate that the cow comes into heat whilst the young animal is still small. But the relatively large number of older calves with adult females (see table p. 144) and the fact that in the 1954 case the rhino cow was tracked until August 1956 in solitary state with her calf, make it probable that the females do not become pregnant again so soon after a birth (see also p. 147). This would be in accordance with what Guggisberg (1966) writes on the black rhinoceros: "A cow with a small calf is never seen together with a bull, but a male may join her once the youngster is fairly big."

Schenkel (1969: 130) suggests that the interval between parturitions varies from 2.5 to 3 years, probably only on account of his experiences with the African black rhinoceros.

In the above all the observations relating to very young animals have been reviewed. One more may be added relating to a perhaps not so young animal, from P. F. Franck (1935), who in about 1928 observed a rhino cow accompanied by a calf estimated to be one year old; data on this age estimate are lacking. There is also another observation by one of the guards, who reported having seen a *pregnant* rhino on 24 July, 1941!

It seems out of the question that by means of the established presence of rhino calves we can arrive at a more favourable appraisal of the rhino population in the reserve than on the strength of the number of rhino established as running in pairs—even if we assume that there were five or six different small calves involved above, instead of only four. The opposite is rather the case; one gains the impression that even fewer young rhino are born than the number of pairs suitable for reproduction might lead one to believe. A somewhat more favourable impression is obtained from a critical survey of the number of semi-adult individuals established as having a fore foot width of up to and including 25 cm, which is given below.

A comparison with Thom's experiences (Sody 1959:199) that the young of *Rhinoceros unicornis* are seldom encountered and that during the 49 years he spent in Burma he never saw or tracked a calf has little point as long as no more is known about the number of adult animals involved and the way in which that conclusion was arrived at. In any case, this opinion is at variance with later statements made on different occasions by Gee (1952, 1953) from which it emerges, among other things, that during three trips made at the beginning of November 1951 in the Kaziranga reserve (Assam) he saw 19 rhino, including three calves, of which two were new-born. Willan (1965) writes that in the Chitawan Wildlife Sanctuary in the Rapti River valley in Nepal and in the Mahendra National Park 35 calves were seen between January and September 1965. However, no comparisons can be made on this point with *Rhinoceros sondaicus*, whose habitat is extremely impenetrable.

PARTICULARS ON SEMI-ADULTS IN THE RESERVE

Judging from the physical dimensions of the individuals observed, semi-adult rhino were only rarely *seen* for certain, but on 24 October, 1938, such an animal was grazing among the shrubs beneath a blind situated near a banteng drinking place in the Niur area. Among the two animals poached in February 1939 along the Tjigenter (p. 19) there was an immature specimen. From the fact that the reports of the guards do not make any mention either of semi-adult rhino, it may be derived that their number was small, but it is also possible that they were not recognized as young because of their rather rapid growth, since these guards recorded visual observations only; prints were not measured. The data collected by them were confined for various reasons to the simplest matters, and these did not include the measuring of rhino spoor.

A survey follows (p. 144) of the number of semi-adult rhino tracked for certain by the present author which are assumed to have reached the age of at least 1 to 2 years and do not exceed an age of 3 years.

The author is of the opinion that Javan rhino with a front foot width exceeding 22 cm are definitely older than a year, and may be estimated at 2 to 3 years, when they display a fore foot width of 24-25 cm. The measurements made on the footprints of the "Karang Randjang calf" form the chief basis for this estimate, together with the much greater print width of definitely adult specimens. This calf, which was still with its mother, had a fore foot width of 23 cm (in soft sand) in August 1956—almost two years after the first observation as baby. Strangely enough, in the literature no single reliable piece of information on this point has been found.

In this case too Dr. H. Wackernagel of the Basle Zoo was so kind as to take a series of such measurements in 1966-1968 on calves of *Rhinoceros unicornis* exceeding the age of six months born in that zoo; the results are given below. As is the case with the other measurements obtained from the Basle Zoo some of them were later put at the disposal of Schenkel and published by him (1969: 127, 128).

Footprint measurements (in cm) of larger calves of *Rhinoceros unicornis* born in the Basle Zoo

	age	width of fore foot	width of hind foot	width of fore hoof
female	over six months	18-20	17-18	8-10
	15 months	22-23		12-13*
	21 months	24-25	23-24	12.5-13
	26 months	24-25	22-23	11
male	almost seven months	20	17.5-18	9-10.5
	9½ months	22-23**	20	12-13**

* these large measurements when compared with those of the calf when 6 and 11 months older may be caused by a different substratum.

** these measurements exactly agree with those of a female calf of 15 months.

Considering these figures, it is not impossible that the presumed age of semi-adults of *Rhinoceros sondaicus*, displaying print measurements as shown above and in the following table, relate in part to individuals which were younger than estimated by the author and that the age of 2-3 years presumed for individuals with a foot width of 24-25 cm is somewhat too high. An indication in that direction may be found when comparing the fore print dimensions as found in Basle for a female of 15 and a male of almost 10 months, 22-23 cm, with those of the "Karang Randjang calf" (a male) for which a fore print diameter was established of 23 cm at an age of about two years. This size is even smaller than the one found in the Basle Zoo for a female calf aged 21 and 26 months (24-25 cm); the fact, however, that for this animal a fore hoof diameter of 12.5-13 cm was found, which was uncommon even in the biggest adults of *Rhinoceros sondaicus* in Udjung Kulon, suggests that some difference in the technique of measuring, or in the character of the substratum on which the footmarks were measured, may have influenced the results. For the time being, the author therefore prefers to adhere to his estimates; as a consequence he is of the opinion that rhino calves displaying a fore print width of 23 cm aged approximately two years, are in any case older than one year. In view of this it may be assumed that none of the solitary rhino calves indicated in the table to be given below were younger than a year; probably most of them were considerably older.

The rapid growth of *Rhinoceros unicornis*, born in captivity, which is evident from the print size given above and the figures given in the table, was already demonstrated earlier by Lang (1961). Two young in the Basle Zoo had a birth weight of 59 and 70.5 kg; a male specimen aged three months already weighed 215 kg, and a female 242 kg, while a bull at the age of 33 months weighed 1,325 kg, which is about 64% of an adult rhino bull weighed in that zoo, and a rhino cow aged 21 months weighed 1,007 kg or 62% of an adult rhino cow. These two young animals had a shoulder height of 157 cm and 136 cm. There is little reason to suppose that the animal's development in nature will be a different one in this respect, because it is also known from other rhino species (Guggisberg 1966); therefore a similar rapid growth is to be expected in *Rhinoceros sondaicus*. This fact long remained unknown in any case as far as the Asian rhino species are concerned; this is why so many observers over-estimated the age of the young still accompanied by the mother (pp. 146-147). As will be evident below, in many of his reports Schenkel too over-estimated the age of most of the rhino tracked by him and his parties.

With respect to the black rhinoceros Guggisberg (1966) writes: "At first it grows very fast and then slows down but, according to observations in the London Zoo, it goes on growing until after it has reached the age of nine years. Ritchie is probably right in assuming maturity to be reached at about the age of seven rather than at five, as is usually stated." The print measurements published above, however, do not exactly point to a slowing down of the development in the second year of life, for the diameter of the fore print of the female calf mentioned above showed an average increase of 5.5 cm between the 6th and the 21st month of life.

As is evident from the particulars given earlier in this monograph adults of both

Asian *Rhinoceros* species probably do not differ too much from one another in weight. A two-year-old calf of *Rhinoceros sondaicus* would in that case already be several hundred kg heavier than a heavy banteng bull!

In the table below of the semi-adult rhino tracked in Udjung Kulon, the first figure is the greatest width of the front foot as impressed into the ground, measured from edge of inner toe to edge of outer toe, while the second figure is the greatest width of the fore hoof of the same foot. In the cases where the latter measurement could not be made properly, only the former dimensions are given. The semi-adults established on the strength of these measurements, and assumed by the author to be different individuals, are numbered 1-14; not included in the table is the "Karang Randjang calf", since this animal is discussed above when considering the calves below the age of one year.

Survey of the semi-adult rhino determined on the strength of print measurements

	Running with adult specimen, almost certainly the mother	Encountered in solitary state
2 September, 1937		No. 1, 23-24.5 cm
10 " 1937		No. 1, 23.5 cm
12 " 1937		No. 2, 24.5-25 × 11 cm
16 " 1937	No. 3, 22 × 8.5 cm	
24 " 1937	No. 3, 22 cm	
24 October, 1938		large calf observed from close by *)
February 1939	killed together with the mother*	
24 September, 1942		No. 4, 24 × 8-9 cm
26 " 1942		No. 4, 23 × 9 cm
30 " 1942		No. 5, 24-25 × 11 cm
3 October, 1942		No. 5, 24-24.5 × 11 cm
12 January, 1943		No. 5, 25 × 10 cm
15 " 1943	No. 6, 20-23 cm	
20 " 1943	No. 7, 20 × 8.5-9 cm	
30 November, 1950	No. 8, 23-25 × 8.5-9 cm	
25 September, 1953	No. 9, 24 cm	
25 November, 1954	No. 11, 24-24.5 × 8.5-10 cm	
28 " 1954	No. 10, 20-22 × 8-9 cm	
25 February, 1955	No. 10, 21-22 × 8-9 cm	
1 March, 1955	No. 11, 24.5-26 cm (together with adult ♂♀)	
3 " 1955	No. 12, 25 × 11 cm	No. 11, 24 cm
4 " 1955		
4 " 1955	No. 10, 20-21 cm	
24 July, 1955	No. 13, 22-23 × 9-10 cm	
14 August, 1956		No. 10, 24 cm
23 " 1956	No. 14, 21-22 × 8 cm	

In 15 cases calves were tracked, accompanied by the mother, relating to 10 different couples.

11 solitary calves tracked, 6 different individuals of which 2 were perhaps the same as previously tracked when still accompanied by their mother (Nos. 10 and 11).

* These animals were further left out of consideration, since they might have been rhino whose tracks had been measured prior to their death (Nos. 1, 2 or 3) and in the case of the solitary young prior to the day of observation.

This table shows that in those first days of March 1955 at least eight different rhino, including four semi-adult specimens, were tracked along the beach of the south coast between the Tjibandowo and the Tjitadahan, a distance of only about 9 kilometres!

The semi-adult individual tracked on 24 July, 1955 (No. 13) with a much larger rhino along the south coast was probably also seen by Talbot on 5 September of that year near Karang Randjang—likewise together with an adult female specimen—for he established 22 cm as the width of the fore print. This specimen is wrongly called a baby by Talbot. In the relevant publication (Talbot 1960:55-56), nothing at all is said about the size of this small animal or with regard to the prints measured, but the author has a sketch made by Talbot in the field of the front print of this animal, which displays the width just mentioned. It most probably relates to an animal of about one year old. It is not impossible that this calf was the "Karang Randjang calf", discussed at length earlier in this chapter.

However, elsewhere (Talbot 1964) he states the following: "The smallest track seen, 22 cm, came from a good sized animal, subadult or adult. We must conclude, therefore, that there was no evidence of any young animals at all". Thus what is called a baby rhino in 1960 is considered in 1964 "a good sized animal, subadult or adult". It is true that both these communications do not relate to the same individual, but they refer to young rhino showing identical print measurements.

In the period from September 1937 to January 1943 incl. and from November 1950 to August 1956 incl., the presence of a semi-adult rhino was therefore established 26 times, probably involving 14 different individuals of which three or four may be the grown-up young calves mentioned on pp. 138-140. In August 1956 there might have been two semi-adults of about the same age, because besides the "Karang Randjang calf", displaying a fore foot print of 23 cm on 16 August (perhaps identical with No. 10, measured on 14 August), there was the one in the table with a fore print of 21-22 cm established on 23 August.

Besides the prints which could be measured, a small number of cases were noted in which, though it was clear that tracks of semi-adult individuals were involved, usable measurements could not be made. On the other hand, because of their outstanding importance, *all the prints* observed of very small animals (foreprint of 20-21 cm) were recorded, which therefore were tracked not more than six times, with a fair degree of certainty relating to four different rhino. True, the number of visual observations by the guards (25) and the author (2) of small calves amounted to 27, but it is clear that in the majority of cases only two different calves were concerned.

When comparing the number of semi-adults indicated in the survey given above with the estimated numbers of juveniles under the age of one year, mentioned on p. 141, one must conclude that the semi-adults outnumber the younger ones. This, however, may be a wrong conclusion because in this category animals are incorporated varying in age from one year to about three years, thus covering two years and as baby rhino are considered individuals in their first year of life only. Moreover, in the survey of semi-adults may have been erroneously included a few rhino

under the age of one year (Nos. 7 and 10 perhaps, displaying footprints of 20 and 20-21 cm). There is also a possibility that the number of semi-adults is exaggerated and that, notwithstanding all precautions to prevent this, some individuals considered as different in the table were in fact the same. But, nevertheless, when considering the observations relating to semi-adults, the situation seems somewhat more favourable than a look at the presumed presence of younger rhino would suggest.

The author does not believe that females accompanying small calves are inclined to conceal themselves, although there are excellent opportunities in the many extensive areas covered with a thorny scrub jungle almost impenetrable for humans. The experiences with the "Karang Randjang calf" and the observations on such a calf at the wallows disprove exceptional wariness on the part of the cow. Another reason for overlooking young calves may be found in the small dimensions of the footprints, but this is not very probable either, since extremely thorough attention was paid to such footprints which, after all, are much larger than those of any other mammal living in this area.

Schenkel's figures (1967) and those given in *Oryx* (Anonymous 1968) also point to a striking difference between sub-adult and younger animals, though Schenkel at that time was wrong in assuming animals showing footprints of 24-26 cm being adult females; these figures partly point to semi-adults of both sexes.

Talbot (1964) gives no evidence to support his statement: "During the past decade, six young rhino have been reported", though this would be of great importance in appraising the present situation. The same applies to the very optimistic statement by Kusnadi P. Satmoko (1961): "Last year some five calves were observed".

A more recent communication in *Oryx* (Anonymous 1968^a) mentions the presence in 1968 of "a Javan rhino calf only three to five months old together with a year-old rhino", but no footprint measurements or other details are given.

On account of the very favourable reports on the presence of young calves and immature rhino in the period 1967 to 1969 inclusive, when compared with the situation as pictured above up to 1957, the present author will return to the subject later (pp. 148-152).

THE PERIOD IN WHICH COW AND CALF ASSOCIATE

All the statements made in the literature point to the calf remaining with the cow for a long time in the case of *Rhinoceros unicornis*. Hodgson (1834) says two years, and D'Arcy Weatherbe (1939) writes: "The greatest living expert on the subject, who has for years tracked and hunted *Rhinoceros*, and who has shot both *sondaicus* and *sumatrensis*, believes from his long experience that the period of following the mother is much nearer six years". Weatherbe does not inform us further of the name of this expert.

Bruton (1963) writes: "The calf is slow in maturing and travels with its mother for many years, even longer than may obviously seem necessary", without any

indication whether this statement is based on his own experience or taken from the literature.

According to Sody, Mitschell remarked in general that the calf accompanies the mother until it is practically adult, which would probably be the case after 7-8 years. Kerkhoven, too, claims with regard to the Javan rhino that the calf stays with the mother until it is nearly adult. The author's previous communication (Sody 1941:112) that a young rhino of about 8 years of age was still accompanying the mother must be regarded as a mistake (this was probably a misprint, 8 instead of 3).

If the spoor measurements taken in the Basle Zoo are applied as a standard, none of the calves indicated in the above table which still were accompanied by the cow exceeded an age of about 2.5 years. However, the possibility remains that the tracked rhino supposed to run in pairs were in fact partly cows with a large calf, since individuals exceeding a fore print width of 25 cm were no longer regarded as young when considering rhino going in pairs. If the observations discussed above, relating to rhino of different sex running in pairs, were indeed partly those of a cow and calf, the number of adult pairs would be still smaller than the supposed amount mentioned on pp. 129-132!

In the case of the African black rhinoceros Guggisberg (1966) found calves aged 2½, 3 and even over 5 years still accompanied by the cow, of which it was certain that she was the mother.

On the strength of the experience gained in the Basle Zoo the period of the cow and calf running together is probably shorter than was assumed until recently. A cow which had calved on 14 September, 1956, became pregnant again as early as April 1957—i.e. after seven months. During the introductory part of the mating (courting) the calf was kept apart, but afterwards readmitted to the mother which, two days before the birth of the second calf, which took place on 17 August, 1958, no longer tolerated it in her vicinity. This calf was thus rejected at an age of about two.

Since it has proved at Basle that a cow can be in heat again two months after a birth and the possibility of conception must therefore be considered to be present, this may also occur in nature, and calves of barely eighteen months of age (at the birth of the second calf) could already be rejected. It may be that in Udjung Kulon too rhino come into oestrus whilst the young are still small—as may be suspected from what was said on p. 141—but a successful conception need not be the result.

Since the exact age of the solitary semi-adult rhino tracked by the author is not known (see table), allowance must be made for the possibility that their numbers include specimens which were rejected at an age of about 18 months (shortly before the birth of the second calf). However, it is not probable that in Udjung Kulon such large calves will later rejoin the cow, since this should have been reflected in the tracks, but not once was an adult rhino tracked in the company of two calves.

This seems to occur with the white rhinoceros. Guggisberg (1966) writes: "Occasionally she allows the previous calf to come back some time after the

birth of her current offspring. In certain areas, for instance in the Amboseli Reserve, several former calves may temporarily rejoin their mother, but this must be regarded as rather unusual in the case of the black rhino".

The question posed by Gee (1953^a) with regard to *Rhinoceros unicornis*: "Does it use its horn for steering its calf when the calf runs in front of the mother, as in the case of the African rhino?" cannot be answered for *Rhinoceros sondaicus*, since the author almost without exception saw the calf running behind the mother on 3 January and 13 February, 1941 (pp. 120, 123). On 13 February, however, the author got the impression that at first the calf was running in front of the cow.

Lang (1961) states with respect to the former species in captivity that at first the calf ran just behind the mother; after about a month it was seen running both in front of and behind the cow, without it being possible to speak of any particular rule. Perhaps this also applies to the Javan rhino.

Later (1964) Gee writes that in the case of *Rhinoceros unicornis* the small calf runs in front of the mother, but he adds: "This precaution would not be necessary in the case of browsing rhino in scrub tree forest". The latter assumption does not seem very logical, since such young animals can be taken by surprise in thick undergrowth by tigers just as easily as in the habitat where *R. unicornis* is usually found.

CONCLUSIONS

The exact age of the rhino designated above as semi-adult for Ujung Kulon does not seem essential to an appraisal of the population in this sanctuary; in any case they were not yet adult animals and they had passed the baby age.

What is of outstanding significance is that, as a result of the poaching pressure, the number of breeding pairs has been reduced to so low a level that, without far-reaching administrative improvements, the population increase cannot be considered adequate to guarantee the survival of the species.

The determination during a 14-year period of 14 different semi-adult rhino—which might be exaggerated, as suggested above—probably also including the four or five very young specimens tracked in 1941 and 1952, cannot of course be regarded as a promising situation. And if it is true that during the survey made by Talbot at the end of 1964 only one 22 cm print was measured and that this was the smallest seen, the presence of about 50 rhino claimed by that author cannot possibly be accepted as correct, as indeed is clearly demonstrated by Schenkel.

As stated above, there can be only one fundamental reason for this unfavourable situation, viz. too small a number of pairs suitable for reproduction, caused by the uninterrupted poaching to which this species has been exposed for years. If the author's 1937 estimates approximated the actual situation and the number of rhino in this reserve was about 25, i.e. 10 cows and 15 bulls, which would be a much more favourable sex ratio than can be substantiated by the author's later experience, it is clear that no spectacular increase could be expected. In addition this number must have included individuals which were not yet sexually mature or too old for reproduction, as emerges from the survey of the semi-adult specimens

tracked in 1937. Reproduction is also handicapped by the long period of gestation and the lengthy span of time during which mother and child may stay together. And, last but not least, continuous poaching must have prevented a normal propagation or might have neutralized the small population growth.

Although the author, in the absence of any indication, does not consider it probable that predators and in the first place tigers have contributed towards this highly unsatisfactory situation, this may not be entirely excluded (see also Chapter 34). At the present stage the annual predation of only one baby rhino would mean a serious threat to the survival of this species of rhino.

From the figures given in Chapter 10 it is evident that in the decade prior to 1965 13 rhino were clandestinely killed, which is most probably more than the increase by births during that period, provided the author's figures on semi-adult rhino as given above may be used as a standard. If the situation were as favourable as the 1964 Talbot report suggests, then there would have had to have been about 47-50 rhino around 1954 (after the killing of the 13 mentioned above, the number was still estimated at 47 at the end of 1964 and only one young was tracked). In the case of a 1:1 sex ratio as is stated in that report, the question imposes itself why, in such a favourable state of affairs, no small calves at all were seen or tracked, which is stressed in that same report as a disturbing fact. This is inexplicable within an area where this species has flourished excellently since memory and where in the last 25 years at any rate a number of viable young were born. It is equally inexplicable having regard to the experience with *Rhinoceros unicornis* in the Kaziranga reserve (Assam), about which Gee (1952^a) writes: "It is my personal view that the numbers of rhino rose from the much depleted stock of a dozen or so in 1908 to about 400 in 1940, but have now become reduced to some 250. For the sake of being on the safe side, however, I prefer to abide by the more conservative estimate of 150".

The above-mentioned figures taken from the Talbot report are also at variance with a number of a "few dozen" mentioned earlier by the same author, on the basis of a visit paid to Ujung Kulon in 1955 (Talbot 1960: 50): "In the population of a few dozen animals, only one or two young are known to exist, and perhaps the population has reached such a low level that adequate reproduction may not occur".

The only acceptable explanation for a lack of young at the end of 1964 is that the estimate of 47 rhino is too high. As a result, too optimistic a picture is given of a situation which is in fact alarming.

The author consequently fails to see what grounds Verschuren (1967) has for writing: "We have already mentioned that the results of the census made by Dr. Talbot in 1964 seem to us to be extremely accurate."

That the figures stated by Talbot are too high emerges from the data now presented by Schenkel (1967) when visiting Ujung Kulon for the first time. He then estimated the total number of rhino still present at 21-28, subdivided as follows: adults (usually fully adult males, footprint 28-30 cm): 8-11; adults (usually females and perhaps a few subadult males, footprint 24-26 cm): 9-12 and immatures (footprint 20-22 cm): 4-5 specimens.

The method used by Schenkel to arrive at the determination of the sex differences is not evident from the figures given. As stated on p. 74, the present author measured the largest footprints in the case of females; no indications were found that the male specimens left larger footprints on average than the females, so that the prints regarded above as originating from male rhinos may equally well have been made by females. It is highly improbable that the prints stated for this category all related to *sighted* rhino, for they will doubtless form an average of a large number of measurements made without the animals themselves being encountered.

The same applies to the second group, in which rhino with a footprint of 24-26 cm were placed, it being assumed that they were mainly females. However, it is clear from the details given earlier in this chapter that subadult animals must largely have been involved here, in part specimens younger than 3 years, without it being possible to say anything about the sex. The author never established an adult rhino with a footprint 26 cm wide that was accompanied by a young specimen, and there is no proof that females of this rhino species with such a small print do in fact produce young.

As regards the third category it may be assumed, with reference to the particulars previously given in this chapter, that this includes in part individuals younger than one year; it is therefore incorrect to speak of "the complete lack of calves less than 1 year old". Schenkel does not say whether the four or five individuals which he or his parties tracked, with a footprint of 20-22 cm, were running alone or in the company of an adult specimen. The present author never established a *solitary* young rhino with this narrow footprint. Since Schenkel does not mention any observation of adult rhino accompanied by young it is almost certain that these small footprints belonged to solitary animals, which makes their correctness rather doubtful.

Tracking such young animals (always accompanied by an adult female) was a rare occurrence. For this reason doubt is expressed with regard to the four or five *different* calves which, to judge by the footprints measured, were hardly a year old, and which Schenkel states were established during only five visits paid to the sanctuary within six months.

A number of 13 to 17 young specimens, most of which had hardly reached the age of three years (maximum footprints of 26 cm), is unacceptably high in comparison to the 8-11 really adult specimens mentioned by Schenkel, taking into account the long period of gestation and the other difficulties in reproduction put forward by the same author.

Above it has been demonstrated that for about 14 years one young rhino was born per year on average; for that reason too Schenkel's figures are doubted. It is obvious to assume that the measured footprints forming the basis of Schenkel's estimates relate to considerably fewer individuals than he supposes; this may have been caused by the fact that tracks of the same animal were recorded as originating from two or more *different* individuals.

An over-estimate for the non-adult animals seems self-evident, since five pairs of adult rhino (with the added assumption that the adult rhino tracked were equally

also supported by the same 1969:127

divided among both sexes) cannot possibly produce at least 13 calves within 3 or 4 years. Probably the number of adult rhino has also been over-estimated. At various places it is evident from the observations recorded by Schenkel that there can hardly be any question of a rosier situation regarding the adult rhino than that established by means of the prints, so that the state of affairs seems extremely sombre.

Later, after comparing his measurements with those obtained from the Basle Zoo of *Rhinoceros unicornis* Schenkel (1969: 126-129) arrived at the conclusion that footprints of the frontleg measuring less than 20 cm must originate from calves below the age of 6 months, those measuring 20-23 cm from animals aged 6-12 months and those of 24-25 cm from individuals of 1-2 years. For adult cows and subadult bulls 26-28 cm and for adult males and largest females 29-30 cm are given for the width of such prints. On the basis of these figures he estimated for 1967 the stock at 7 adult males and largest females, 9 adult females and subadult males, 5 calves of 1-2 years, 2-3 calves of $\frac{1}{2}$ -1 year and 1 calf below the age of six months. For 1968 these figures were supposed to be 10, 10, 3, 1-2 and 1 respectively.

These figures, obtained between March and November 1967 and in about the same period in 1968, call for some further comment. In accordance with that estimate there should have been 13 adult males and females when it is assumed that among the 9 adult females and subadult males were 3 immature bulls which had not yet taken part in reproduction. This means that 6 pairs were present when accepting a 1:1 sex ratio as is assumed by Schenkel. He suggests (1969:130) that calves up to the age of 2 years (in 1967 8-9 individuals) are accompanied by their mother, so that all available cows were occupied with the care of young. From this it would be evident that (with a gestation period of 16 months) no female was left to give birth to another calf in 1968; yet in that year another 2 or 3 calves below the age of one year were recorded and according to World Wildlife Fund's press communication No. 122 of 28 October, 1969, another 2 or 3 calves aged about one year, in 1969.

Such an increase seems far beyond the possibilities unless a considerable number of the available mother-rhino became pregnant when still accompanied by a calf, but even then such a favourable birth rate would hardly have been possible. Since no tracks of three associating rhino—a bull and a cow in the company of a calf—have been reported by Schenkel and this was also of very rare occurrence during the study by the present author, it is unlikely that pairing of female rhino when still accompanied by young, takes place in Ujung Kulon. If calves are rejected by their mother at an age below 2 years, the footprints of such singly wandering individuals should have been found much more frequently than actually was the case.

Schenkel (1969: 131) writes: "its reproduction is not abnormally low" and (l.c.: 133): "The small rhino population of Ujung Kulon seems to reproduce adequately"; if his figures were right the propagation could actually be called brilliant! It would then be inexplicable that the situation remained so bad in the period 1937-1945 and during 1950-1957 when poaching was most probably less serious than in the last decade and the habitat appeared to be in good shape (see also p. 153).

Schenkel's own experiences in this sanctuary are contrary to such a favourable state of affairs, because he hardly reported on phenomena relating to pair forming and rut, while there is no clear evidence that he actually saw a rhino cow.

As is evident from the particulars given in the first part of this chapter, during the author's entire working period, with a very bad rhino situation, considerably more details connected with pair forming and rut were established; yet the number of young recorded was much smaller than reported by Schenkel. If indeed so many young rhino are present in Ujung Kulon, the number of adults must be considerably larger; there are, however, no indications that this is the case.

CHAPTER 17

SUGGESTIONS FOR IMPROVING THE PRESENT UNSATISFACTORY SITUATION

It will be clear that the creation over sixty years ago of statutory provisions to protect the rhino, and also the granting of the status of nature reserve to Ujung Kulon, also almost half a century ago (changed to that of game sanctuary over 15 years later) have not been able to prevent the Javan rhino from being on the verge of extermination. Nevertheless, this set of protective measures has rendered possible the survival of the species, which at the beginning of this century already seemed to hang in the balance.

Although for the time being it is not necessary to take other steps with regard to the rhino of Ujung Kulon than those laid down by the statutory provisions, the most urgent measure is ensuring that the sanctuary is adequately guarded; this is a *sine qua non* for saving *Rhinoceros sondaicus* from disappearing. Only when surveillance is adequately regulated can other means of expanding the rhino population be sought.

Although enforcement of the ban on possessing parts of the bodies of rhino and products made therefrom may be of great importance in combating poaching, it has been found in the past that in the circumstances as they are today top priority should be given to intensive guarding of Ujung Kulon. That there was no question of such surveillance until recently is evident from the communications of Talbot (1964) and Pfeffer (1965), pointing to the known death of 13 rhino during the last decade, six of which within one single year, according to Pfeffer.

Schenkel (1967, 1969) likewise repeatedly stresses the great urgency of an effective guarding of the reserve; his reports also show that the necessary patrol paths were completely impassable in mid 1967 and that there was no question of regular patrolling. For instance, the Karang Randjang bivouac (south coast), which lies at a particularly vital point, was, he says, reoccupied for the first time around June 1967.

Besides the patrol paths referred to by Schenkel, which after years of neglect require clearing or have already been made passable again, the important path between the Tjidaon, Njewaän and Niur, a heavily wooded area which the author found to be most attractive to rhino, should be made passable again, as should the path between the Tjigenter and the Tjikarang which, among other things, intersects Tdj. Balagadigi. When guarding is restored attention will have to be paid to the tidal forest complex between the Tjihandeuleum and the Tjisimping, which is intersected by several large tidal rivers and numerous creeks (Plate 2). These rivers border upstream on drier terrain, containing very attractive rhino territories. This was the very first area to be guarded in 1938, also because these rivers could easily be sailed up unnoticed by fairly large proas, and in view of the fact that their

banks offer excellent concealment for poachers, who can easily extend their activities to other parts of the sanctuary from there.

According to Schenkel (1969: 100) the area at present "most exposed to rhino poaching is the south coast". During the author's working period the great majority of rhino were killed in other localities. Usually the many valuable parts of a rhino body are transported in a large proa or a motorlaunch; this is impossible along the south coast, bordering the Indian Ocean, but very easy in the regions bordering the Handeuleum Bay.

From a map published by Schenkel (1969: 103) it is evident that up to and inclusive 1968 only a very small part of the patrol paths formerly used (see the map in this monograph) are reopened and that such paths are absent around the entire Mt. Pajung area and also along the northwest, north and northeast coasts of the remaining part of the sanctuary. He gives no particulars about the way in which guarding is performed at present. Schenkel writes (1969: 99): "Finally in 1937 Ujung Kulon together with the adjacent Panaitan (Prinsen-) Island, was declared a Nature Reserve, and a small guard organization was established." However, the present author would feel much happier if he could be convinced that guarding today was just as thoroughly organized as it was in those prewar years and again between 1950 and 1955 (see map opposite p. 30).

Although it seems attractive, in view of the great success achieved in recent years in the Basle Zoo with the breeding of *Rhinoceros unicornis*, which is presumably closely related to our species, to toy with the idea of trying the same thing with the Javan species—though for the time being only in one or two tropical zoos—the author is not in favour of this. His principal objection is that it is not known at all how many breeding pairs are still available in the reserve. Trapping even one single pair and withdrawing these two animals from the local stock would greatly increase the risk of extermination, not to speak of the damage or disturbance which might effect the remaining individuals. Serious disturbances are unavoidable within an area as Ujung Kulon is, when the number of females is indeed so small as the present author supposes to be the case, because it then will be inevitable that several bulls are captured until the first female falls in human hands.

Moreover, if the present propagation in Ujung Kulon is indeed as favourably as Schenkel's figures suggest artificial breeding may be considered off the point. Finally, there will be little apprehension in Indonesia for such a radical interference within a so strictly protected reserve as is Ujung Kulon; it might fling open the door to making an economic object of living specimens of this rare animal, which of course should be avoided at all costs.

A second means of preserving this species from disappearance is the transfer of one or a few breeding pairs to areas outside the densely populated Java, first of all to places where the species is known to have lived before. But as long as there is no complete guarantee that surveillance there will be adequate, such an artificial transmigration is of course not of the slightest significance. For it seems improbable that a sanctuary outside Java can be properly guarded and Ujung Kulon cannot.

Moreover, much too little is known about the biology of these rhino to be able to assume that reproduction will occur if one or more pairs are released in an area as large as or bigger than Ujung Kulon; it is by no means impossible that the animals will lose contact with one another and never meet again.

The only solution is that the Indonesian authorities begin forthwith to realize the great urgency of immediately instituting proper surveillance of the sanctuary.

Although the delegating of biologists and the making available of material and financial support by the World Wildlife Fund, and other organizations such as the International Union for Conservation of Nature and Natural Resources, are signs of good will and therefore are deserving of appreciation, this only partly helps matters. For what is needed at the shortest possible notice is effective surveillance and a reasonably satisfactory management of this area, which is so important from the international point of view too.

Twenty years ago (in 1949) the author was already stressing the desirability of arriving at sound, entirely non-political international cooperation; he wrote the following: "...it would seem to be extremely beneficial if a mode were found, whereby the authorities responsible for the management of these reserves could be brought to accept the assistance of and to confer a certain influence on some international scientific organization".

The desirability of such a conferment seems greater than ever today, but up to now this has not been achieved in a quite satisfactory way, so that *Rhinoceros sondaicus* has reached an unprecedented nadir in its existence.

Earlier in this monograph the encouraging facts have been given of a splendid recovery of *Rhinoceros unicornis* inside the Kaziranga reserve in Assam, India, and of the broad-lipped rhinoceros in the Umfolozi reserve in South Africa, where within half a century populations of 150 and 600 individuals respectively have been built up out of a stock most probably no larger than the number of rhino still living in Java.

The possibility of a rapid recovery is likewise stressed by Verschuren (1967), who writes: "Replacement of animals is not so slow in rhinoceroses, if we remember that in the Garamba National Park, Republic of Congo, the number of rhinos increased from 100 to more than 1000 between 1939 and 1963, due to strict protection".

With these shining examples in mind, it is doubly justifiable to do everything to save the few Javan rhino still alive from extermination. Ujung Kulon is most suitable for this animal, although the number it can harbour is certainly not unlimited. For the time being all that needs to be done is to safeguard this rare species against poaching and other human disturbances to guarantee its survival.

There were no symptoms of shortcomings in the rhino's habitat as far as the author was able to establish during the many years of his investigations. However, if some doubt should arise about the supply of food plants and trees in a suitable age class, an investigation on the available food species is recommended. Since enormous quantities of many of these species (*Glochidion zeylanicum*, *Desmodium umbellatum*, *Premna corymbosa*, *Ficus septica*, *Hibiscus tiliaceus*, *Naucllea orientalis*,

Vitex negundo, *Cordia subcordata*, etc.) are present in the reserve, in most cases the cutting down or pruning of the too heavy specimens, in order to achieve the necessary rejuvenation, might suffice.

Schenkel apparently does not share the author's view as far as the available quantity of good rhino food plants in this area is concerned; this matter was discussed at length in Chapter 14. Because of the very important botanic value of the sanctuary it is of paramount importance to leave untouched the vegetation of the interior until a thorough investigation has made it sufficiently clear that measures as suggested by Schenkel are inevitable.

The author hopes that this monograph may help to make the Indonesian Government aware of its responsibility and prevent it from allowing itself to be robbed by a handful of irresponsible profiteers of one of the most valuable elements of its wealth of fauna, *Rhinoceros sondaicus*.

PART III

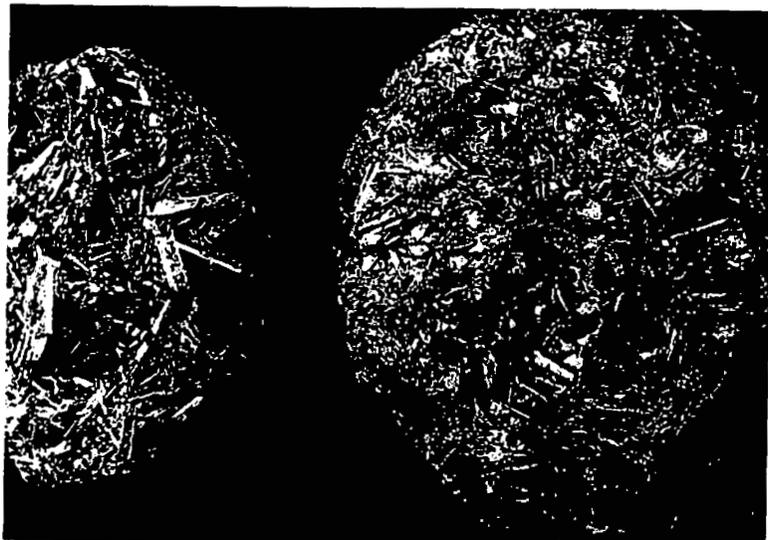
THE BANTENG

(*Bos javanicus javanicus* (d'Alton))

Plates 44-49: facing p. 200

Plates 50-53: facing p. 232

Plates 54-59: facing p. 264



Old, dried-up dung balls and the remnants of small twigs, etc., separated from this dung. Such twig parts always lacked bark remains



A poorly imitated rhino horn, clearly differing from a real one (photo F. Huysmans)



Some objects of art, carved from rhino horns, are the results of skilled craftsmanship in Old China; after Casal, 1938 (photo Zwartser)