the late Dr Thienemann, and as the result of an idea of the president of the zoo's supervisory board, Mr H. Horten. It was opened in July 1965.

The 'Delphinarium' was planned and built as an experiment: it was always intended to be provisional. We had to learn the best way of transporting and keeping these specialised marine mammals in an inland exhibit before we constructed anything permanent. The most well-known dolphin exhibits (such as Marineland and Miami Seaquarium) are near the sea, which means that there are no difficulties in providing fresh seawater and dolphins.

The middle part of the Delphinarium consists of a cement pool, $12 \times 15 \times 3{\cdot}5$ m deep. Two smaller interconnected pools are separated by a sluice where the animals can be locked up at night or where they can be examined and treated when they are ill. We use artificial seawater. The total water quantity of 500 cu. m in the pools is produced by 1,500 kg NaCl with the addition of other salts, chlorine, etc. The whole volume of water passes 12 times in 24 hours through two big filter towers, filled with gravel and $NaAlO_2$ (Natrium-Aluminat, a very strong filtering chemical). Only a small quantity of fresh water is added daily after being warmed by heaters. The temperature is kept at 19 to 23°C in the dolphin pool. The salt content and specific gravity are continually checked and controlled since dolphins are apparently very sensitive to any change. Cod liver oil and oils from fresh herring and mackerel are carefully removed from the water surface after each feeding time. The floor of the pool is cleaned with an underwater vacuum cleaner. As the result, our inland dolphin exhibit always has extremely clear water, even though the pool contains eight Bottle-nosed dolphins *Tursiops truncatus*.

Round the pool there are seats for 600–700 people. The whole construction is housed in a large plastic tent, $40 \times 25 \times 9$ m high, heated and stretched by elastic bellows. Dolphin performances take place three to five times daily. The dolphins leap a hurdle, 'shake hands', lift plastic balls and jump out of the water.

Since the first four dolphins arrived at Duisburg on 11 July 1965, only two have died (soon after arrival). One of them had been crushed during the journey and died from pneumonia, the other from erysipelas.

In the meantime, we have made good progress in the management of these interesting sea creatures and in the preparation of suitable water for them to live in. 'Flip' and 'Flap', two of the original shipment, have kept in good condition ever since they came to Duisburg in July 1965 and we have had no difficulties with a second shipment of six additional dolphins. Using the considerable experience we have gained in running Germany's first dolphin exhibit, we are planning a larger and more permanent Dolphinarium for the autumn of 1966. Windows will be provided in the new exhibit for visitors to watch the dolphins swimming underwater. There will be seats for more than 700 people. Another pool for larger cetaceans, such as belugas *Delphinapterus leucas* or Pilot whales *Globiocephala melaena*, is also under consideration.

The Africa house at Zurich Zoo

C. R. SCHMIDT

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The Africa House for rhinoceroses and hippopotamuses was officially opened in June 1965. The planning of this modern animal building goes back to the general rebuilding project started by Professor Hediger, the zoo's director, in 1954. In April 1962 the people of Zurich voted the 5 million swiss francs requested by the zoo for rebuilding – a unique event in the history of zoos. The motion was accepted by a big majority. One-and-a-half million francs were allocated for the Africa House. Building started in 1963 and finished in December 1964. The architect was Mr R. Zürcher and the construction was directed by Mr M. Perrin.

The building is basically oblong in shape and measures 50×20×8 m high. It is built entirely from reinforced concrete. Characteristic features are two big skylights, insulated with cork, roofing felt and synthetic rubber paint (Prevanol) attached from outside. Beneath each of the two cement cupolas which allow daylight to fall directly onto the animals, are two large dens, each covering 35 sq. m. They are raised a little above the public area and they are separated from it only by a dry moat, 1·8 m deep and 2 m wide. The bottom of the moat is covered with round pebbles so that if the animals should fall in they will not be hurt. If an animal does fall in, it can be led back to its den by climbing shallow steps (situated at either end of the moat) and reaching the den by a special passage.

Instead of being bare cages, unbiologically cubic in shape, the dens were made to appear as 'natural' as possible. (See Hediger, 1956 and 1965.) In many zoos rhinos rub their horns down against the walls by stereotyped movements. In the Africa House tree trunks are fixed in the middle of the inside dens and in front of the rounded back walls of reinforced concrete. They can rub their horns against the wood without harming them. The foundations of the enclosures are made out of the well-proved Leca-isolation cement. The ground is not monotonously flat but is slightly undulating and is decorated with boulders. Inside the house the animals are surrounded by tropical plants.

Between the indoor dens there is a pool covered with Portland cement pneumatically applied over reinforced steel. It is 1·2 m deep and contains 20,000 litres of water. As the only water available in Zurich Zoo is expensive drinking water, the pool has not been made any larger intentionally so that the water can be renewed daily. By means of a 3,000-litre boiler the temperature of the water in the pool is kept at 18°C in the winter. Instead of steps, a natural-seeming bank is provided for the hippos. Daylight comes through a plexiglass cupola (Kupolux).

The public area, 4 m wide, is lit indirectly. On the opposite side there is a semi-circular glass-roofed enclosure separated from the public by a wall. A shoebill *Balaeniceps rex* lives in this enclosure which is also provided with a pool and is planted with bamboo.

Behind the rhino dens there is a corridor covered with 'Stallit' stall tiles. It connects the indoor dens with the outdoor enclosures. It can be divided by iron bars into several sections to form additional cages. It is separated from the enclosures and dens by horizontal sliding steel doors with peep-holes. The keepers rooms, heating equipment and hay loft are also behind the corridor.

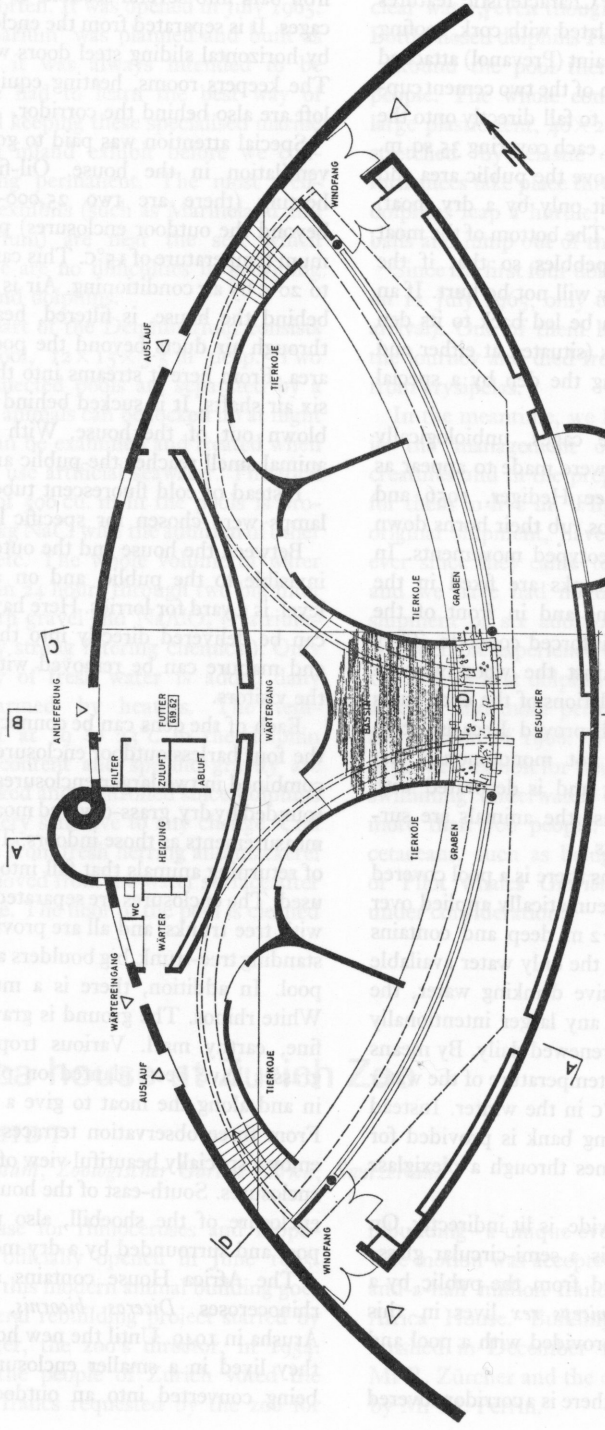
Special attention was paid to good heating and ventilation in the house. Oil-fired hot water heating (there are two 25,000-litre oil tanks beyond the outdoor enclosures) provides a minimum temperature of 15°C. This can be boosted up to 20°C by air conditioning. Air is sucked in from behind the house, is filtered, heated and blown through air ducts beyond the pool to the public area. From here it streams into the dens through six air shafts. It is sucked behind the dens and is blown out of the house. With this system no animal smell reaches the public area.

Instead of cold fluorescent tubes, warmer spot lamps were chosen for specific lighting.

Between the house and the outdoor enclosures, invisible to the public and on a slightly lower level, is a yard for lorries. Here hay and other food can be delivered directly into the large hay loft and manure can be removed without disturbing the visitors.

Each of the dens can be connected with each of the four barless outdoor enclosures. These can be combined in two larger enclosures, which are surrounded by dry, grass-covered moats with the same measurements as those indoors. The same method of returning animals that fall into the moat is also used. The enclosures are separated by walls hidden with tree trunks, and all are provided with a free-standing tree-trunk, big boulders and a 20,000-litre pool. In addition, there is a mud bath for the White rhinos. The ground is gravel covered with fine, earthy marl. Various tropical plants and grasses have been planted on plant islands and in and along the moat to give a savannah effect. From three observation terraces the visitors can enjoy a specially beautiful view of the animals and enclosures. South-east of the house is the outdoor enclosure of the shoebill, also provided with a pool and surrounded by a dry moat.

The Africa House contains a pair of Black rhinoceroses *Diceros bicornis*, imported from Arusha in 1949. Until the new house was finished they lived in a smaller enclosure which is now being converted into an outdoor enclosure for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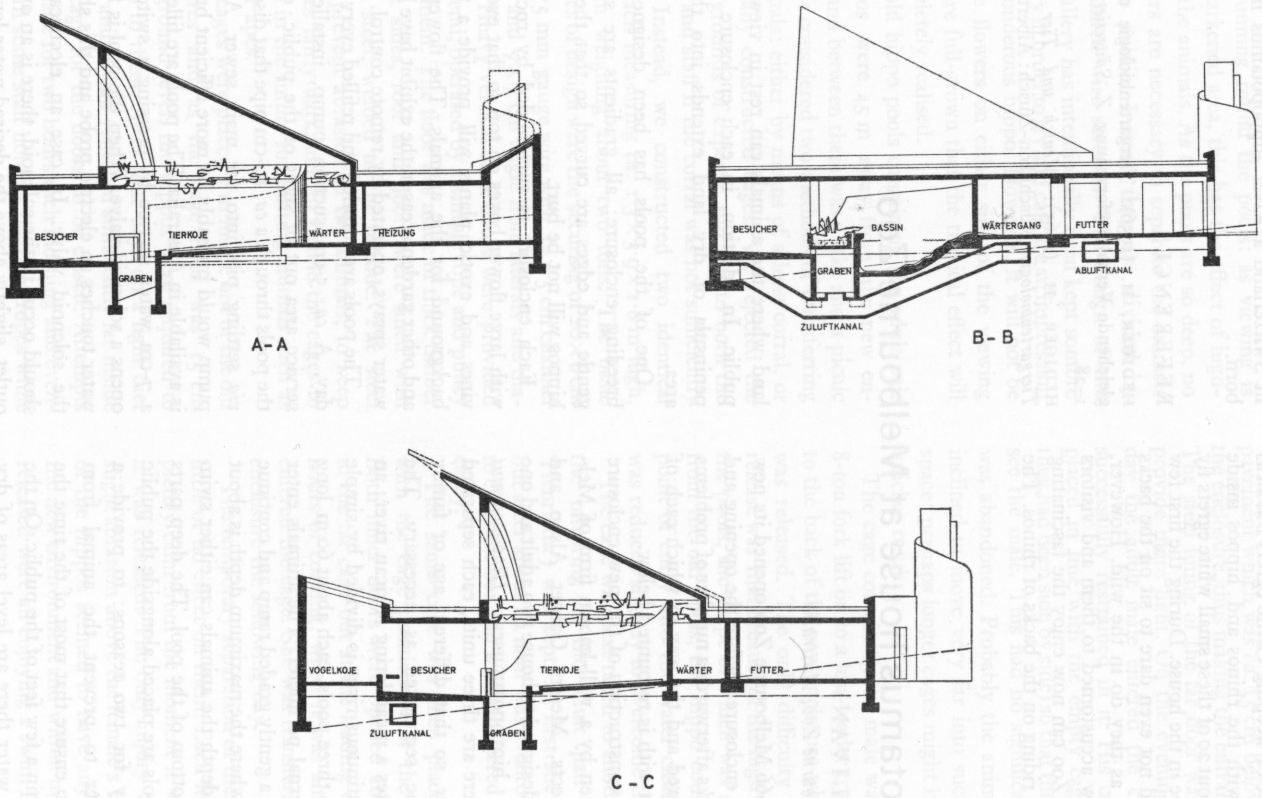

Figure 1. Groundplan and cross-sections of the new Africa House for rhinoceroses and hippopotamuses at Zurich Zoo. (Scale 1:300.)

Brazilian tapirs *Tapirus terrestris*. As the old pair did not breed, a second female Black rhino was bought. Other animals living in the new house are a pair of young] Southern White rhinoceroses *Diceros s. simus*, three hippopotamuses *Hippopotamus amphibius*, and the shoebill.

Perhaps for the first time in a zoo an experiment was made of keeping Cattle egrets *Bubulcus ibis* together with the rhinos and hippos inside the house. About 20 of these small white egrets fly completely free in the house. During the first few weeks they did not even dare to sit on the backs of the rhinos, as they do in the wild. However, they soon grew accustomed to them and visitors to the Zurich Zoo can now enjoy the fascinating sight of egrets riding on the backs of rhinos. The birds do not try and get out of the house as the exit used by the public has double doors, and the animals' exit is a dark passage.

Since the Africa House was opened it has worked extremely well and several animals have already bred successfully: some of the Cattle egrets have hatched young and for the first time in Switzerland a River hippopotamus has been born.

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Hippopotamus house at Melbourne Zoo

J. H. SULLIVAN
Director, Melbourne Zoo, Australia

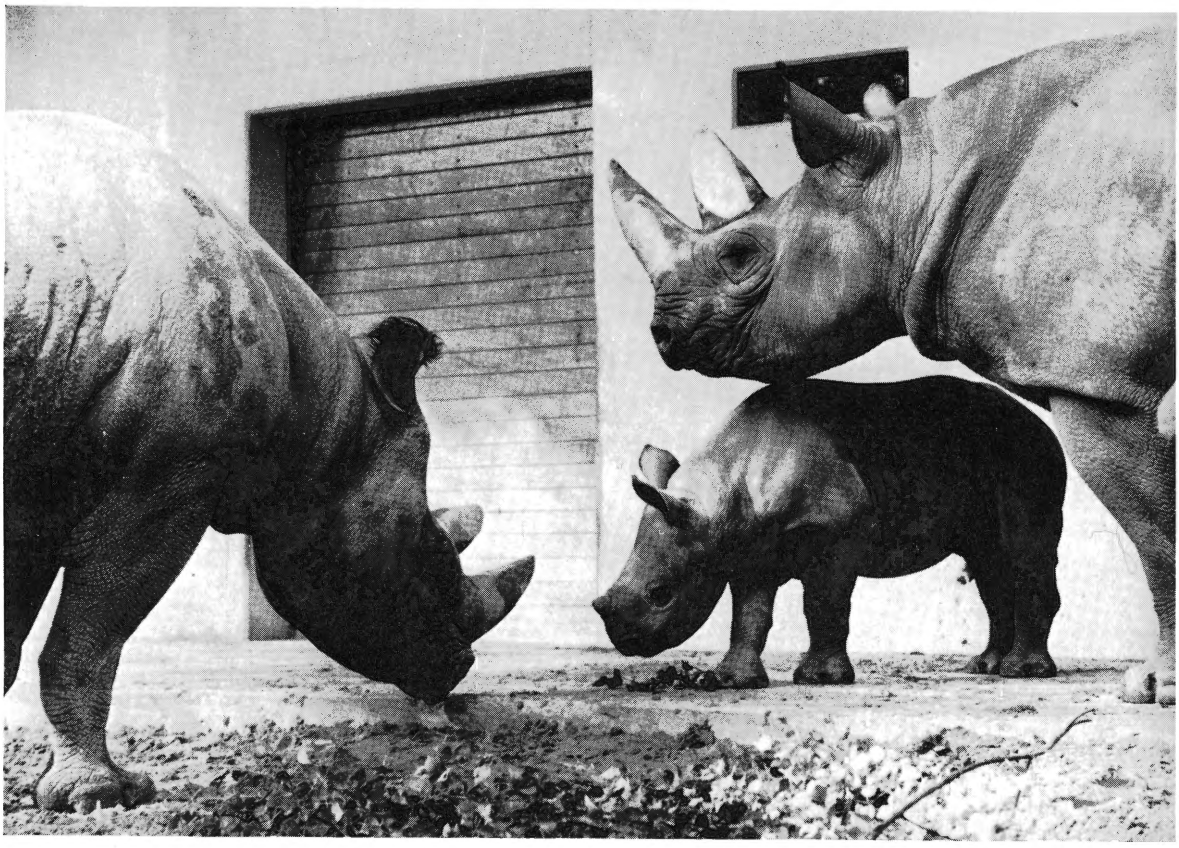
On 15 May 1966 Melbourne Zoo opened its new hippopotamus enclosure. Before the opening and for several weeks afterwards a number of problems were encountered and the way in which each of these was dealt with is recounted below.

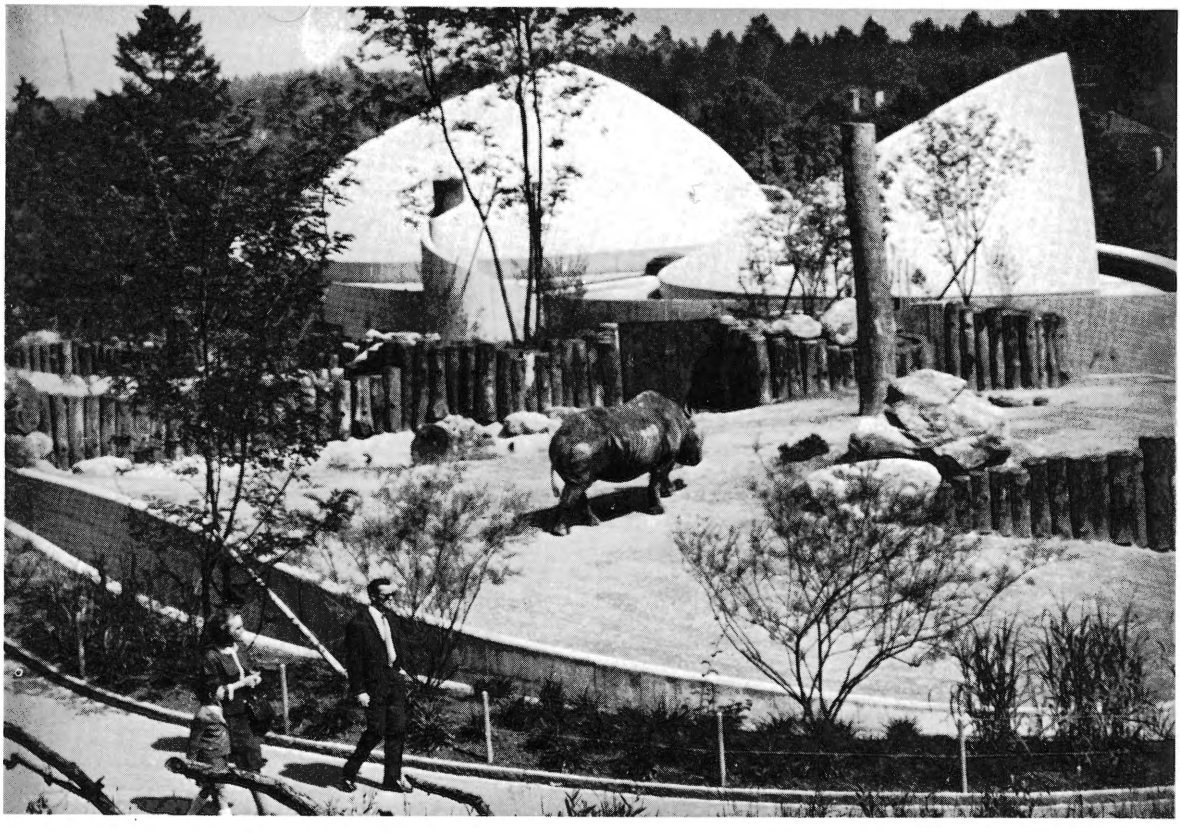
Design and construction of the new enclosure were undertaken by a well-known firm of Melbourne architects, Messrs Garnet Alsop and Partners. It is designed to house two adult and one five-year-old hippopotamuses *Hippopotamus amphibius*. There are three units, each separated from the other, so that different age or family groups can be segregated as necessary. The exhibit simulates a meandering African river: an apparently continuous river is divided by simple rock walls into three pools, each about 60 m long round the external perimeter. The animals enter the water from a gently graded ramp and continue into the pools where the maximum depth is about 1·5 m. At this depth the animals can either swim or lie on the bottom of the pool. The deep parts of the three pools are placed alongside the public viewing gallery for two reasons: to provide a physical barrier to prevent the animal from escaping and to ensure that most of the time the hippos are within a few feet of the public. On the far side of the water there are level areas of dry land where the animals can rest in view of the public. In addition, in each enclosure a small peninsula of dry land extends into the pool area.

One of the pools has been designed as a breeding enclosure: all gradients are specially gentle and edges are curved so that the young hippos will not be hurt.

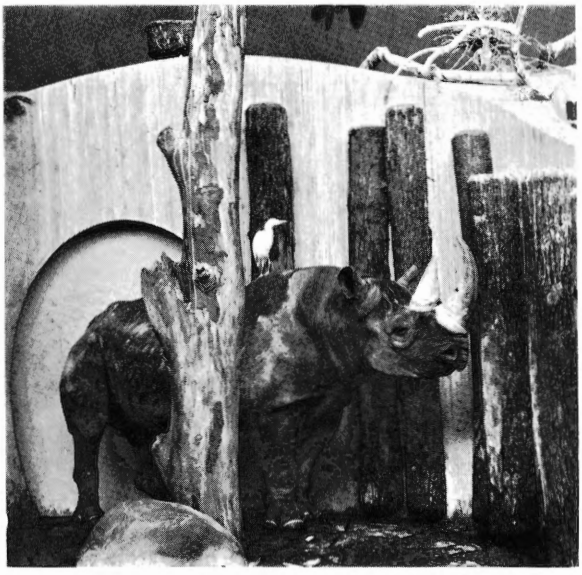
Each enclosure is surrounded by rock walls with large flower boxes on top so that eventually vines and exotic plants will provide a tropical background for the animals. The flower boxes and other garden areas in the exhibit have built-in water sprays, operated by remote control.

The pools are emptied and refilled every second day. A *ca.* 5-cm suction pump, installed in a service area out of sight of the public, empties the pools through a *ca.* 10-cm pipe that discharges *via* settling pits into the main sewer. A larger pump would probably be more efficient but none is available in Australia. The pools are filled from a 7-cm water service by pressing a switch that opens a solenoid valve. When the pool is full the water touches an electric probe and this shuts off the solenoid valve. In case an electrical fault should occur in the solenoid, there is an overflow outlet, slightly above the desired water level.





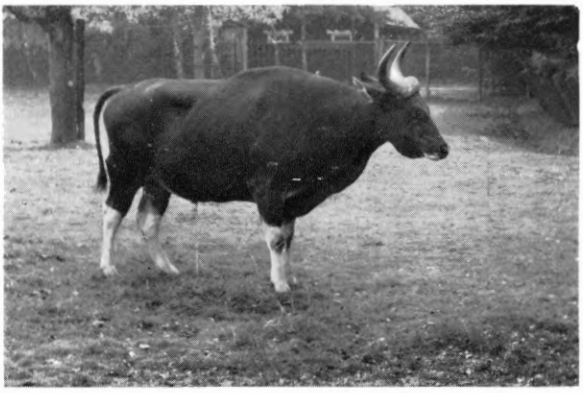
44. *top left.* On 28 June 1965 a male Black rhinoceros *Diceros bicornis* was born at Hanover Zoo after a gestation period of 469 days (see p. 161). In the photograph the four-month-old rhinoceros invites its father to play. Note the young rhino's horn, 4 cm long. The young rhino has since gone to Bristol Zoo.
Zoologischer Garten Hannover



45. *bottom left.* The new Africa House for rhinoceroses and hippopotamuses at Zurich Zoo (see pp. 62-66). Accommodation is provided for three Black rhinoceroses *Diceros bicornis,* two White rhinoceroses *D. simus,* and three hippopotamuses *Hippopotamus amphibius.* The dry moat is 1.8 m deep and 2 m wide.
Jurg Klages Zurich

46. *top right.* A corner of one of the indoor rhino dens in the new Africa House at Zurich Zoo. Instead of being bare cages, the dens are made to appear as 'natural' as possible, with tree trunks for the rhinos to rub their horns on and a slightly undulating floor. About 20 Cattle egrets *Bubulcus ibis* fly free inside the house and often sit on the backs of the rhinos as they do in the wild. Two of the Cattle egrets' nests can be seen at the top of the photograph.
Jurg Klages Zurich

47. *centre right.* A typical pure-bred banteng bull *Bos javanicus.* The banteng is a species whose existence in the wild may soon be endangered: the number living in Java is less than 300 and there are about 30 in Malaya (data for Indo-China and Burma are unavailable). The species flourishes in zoos, given certain conditions (see pp. 222-223), and it may well be saved from extinction by being bred in captivity.
A. C. V. van Bemmel



48. *below.* Female banteng cow and calf at Rotterdam Zoo. Some banteng in captivity have domestic Bali cattle blood. However, the animals in Plates 47 and 48 are typical pure-bred banteng. The pure banteng bull is nearly black with a white rump patch, while the cow is red with the same white rump patch. Both sexes have white legs, though the legs of calves may be brown. The head is long, there is a marked constriction of the neck directly behind the head, the dewlap never reaches the throat and the shoulders are always higher than the rump.
Int. Photopress Office Rotterdam