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Cover Page Footnote

Staff of the Zoological Center, Ramat Gan is greatly acknowledged for its help — in particular, Izik Franco (head, elephant department), Yankele Sapania (elephant keeper), and Rafi Geron (head keeper). In Michigan, USA, Eleanor C. Marsac, Jules L. Pierce, Joann M. Holden, and Jeheskel and Sandra Shoshani are also acknowledged for their editorial assistance.

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HISTORY, UPDATE, AND THE "BABY BOOM" OF ELEPHANTS IN 1987 AT THE ZOOLOGICAL CENTER, RAMAT-GAN, ISRAEL

by Amelia S. Terkel

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Abstract. The Zoological Center, Tel-Aviv Ramat-Gan, Israel, has one of the largest breeding herds of African elephants in captivity. It also has a respectable breeding herd of Asian elephants. At peak population, there was a ponderous total of thirteen African and six Asian elephants in our zoo. Of these, six individuals were born in 1987. In this article I will describe the background of our herds, the animal quarters, and provide some of our interesting observations on the relationships between the newborn and their relatives, bringing the review up to date, 1998.

INTRODUCTION

BRIEF HISTORY AND HERD COMPOSITION

The Zoological Center, also known as "Safari", located in Ramat-Gan (a suburb of Tel-Aviv), was opened to the public in 1974 as a reserve for African animals and animals from the original zoo in Tel-Aviv (Fig. 1), translocated in 1981. The site of the old Tel-Aviv Zoo is now an apartment tower and garden at the foot of the City Municipal Building. The Zoological Center, the largest of its kind in Israel, stretches over 1.3 square kilometers (250 acres), with gardens and ponds, where the public views most of the animals from their cars, and walks through the modern zoo. In 1981 there were twelve African (*Loxodonta africana*) and three Asian elephants (*Elephas maximus*). In 1987 the African herd consisted of two age groups of wild caught females brought from Arusha, Tanzania in 1964 and 1973 as three- and four-year olds. A bull ("Timbo") was brought with the first group, and sired the first generation of two females ("Lara" and "Sara") and a son ("Yossi"). Timbo died in 1978. Today, 1998, the elephant population in the Zoological Center is — 11 Africans, 5 captive- and 6 wild-born, and five Asians, three captive- and two wild-born (Tables 1-3). Over the years, 14 African and 12 Asian calves have been born at the Zoological Center (Shapiro and Terkel, 1997).

In the wild, elephant herds are led by a matriarch which is usually the oldest and most experienced cow (Douglas-Hamilton and Douglas-Hamilton, 1975; Sukumar, 1989). A similar social structure is present in our African herd (Sever, 1982), where the leader (alpha female) is Atari and Motek is second in command (beta female). There are clear and definite groupings among the wild-born cows, with the first arrivals, Bahati, Motek and Atari, dominating the three females in the second group.

HOUSING FACILITIES

The two species of elephants are held in separate enclosures, each of which has night and day quarters. The day enclosure of the African elephants is approximately 6,000 square meter (~7,000 square yards), and that of the Asian elephants is 4,000 square meters (~5,000 square yards). The night quarters of both species consist of large, 4.0 x 7.65-meter (~4.2 x 8 yards) stalls with sloped concrete floors for drainage, walls on three sides

and gates and bars made of galvanized steel pipe frame 15 cm (6 inches) in diameter. The gates connect the stalls with each other, are operated manually, and lock into place in the open or closed position with a pin. At night the elephants are housed singly or in pairs in their stalls. In the morning, the elephants exit their night quarters into their daytime pen by walking through the opened sliding gates. The daytime African elephant enclosure is shaped like a kidney, with a 2.5 meter (~2.8 yards) high stone wall surrounding it. The grounds inside are sloped so that the elephants are viewed at eye level or from slightly above. The flooring is packed limestone soil. At one end of the kidney is a bathing pool for the elephants. The night quarters are visually separated from the day quarters by a planted berm, and the night quarters have grass and trees planted on their roofs. The Asian elephant area is designed on the same principle - hidden night quarters with roomy stalls and a large dry-moated enclosure surrounded by a natural stone wall, with a bathing pool in the middle (Figs. 2-5).

MANAGEMENT

Neither species of elephant is chained. The keepers maintain minimal overall control — including minimal physical contact — over the elephants. We do not use the ankus (elephant hook), and we move animals from one section to the other by positive reinforcement with food, as well as teamwork among the keepers in the use of gates. From 1991 through 1996 the young Asian elephants were worked once a week and on holidays by a trainer. The elephants' natural inclination is to move in and out in a set order, each individual selecting its own stall. All the African elephants respond to the command "trunk up" (in Hebrew), for which they are rewarded with a loaf of bread. Once the elephants are out in their enclosure, their behavior remains a fairly good model of natural herd behavior, and this is what makes the African herd most interesting.

BREEDING RECORDS AND BEHAVIORS

BREEDING BEHAVIORS AMONG AFRICAN ELEPHANTS, *LOXODONTA AFRICANA*

Our "baby boom" story begins in 1985 when the African elephant, Yossi (born in Ramat Gan in 1974; cf. Table 1), apparently reached reproductive age at 11 years. During several months of that year he was most difficult to deal with. Not only did the keepers find it difficult to handle his "moods" but it seemed as though the cows also found him intolerable. When he started making advances to the young females, the dominant females shoved and pushed him to keep him away. Heavy blows by trunks rained down on him from all directions and there was a lot of shoving and jabbing with tusks. Yossi's behavior altered the social balance among the African female elephants. The dominant females "ganged up" on one of the weaker females, Sophie, and she eventually suffered very heavy injuries in her hip area. Yet at other times it appeared as if Atari and Motek cooperated with Yossi in his mating efforts by "trapping" their daughters from the front so that he could mount them. At the time of this violent unrest, Yossi was not the largest elephant in the herd, although he is today 3.3 meters at shoulder height, and possibly, for social reasons, as well as strictly the physical reason of size at that time, he succeeded in mating only with the youngest, smallest females. After this period of mating, Yossi calmed down, and the social life of the herd returned to a more tranquil period.

Over the late months of 1986 and early 1987, it was clear that some of the young females were pregnant. There was much speculation as to exactly who was pregnant and when the births

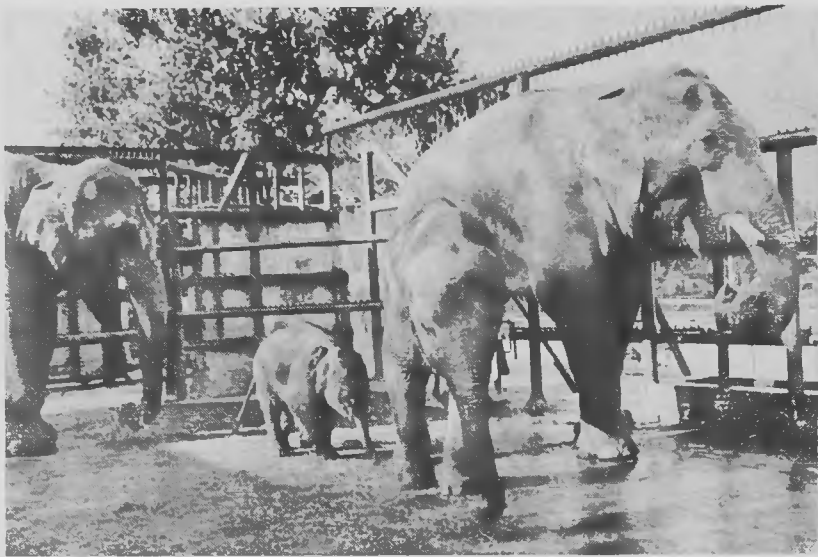


Figure 1. A postcard of the Asian elephant enclosure taken in the previous location of Tel-Aviv Zoo (where an apartment tower and garden at the foot of the City Municipal Building now stands) sometime between 1970 and 1980. The adult female elephant at left is "Varda", and the adult male elephant at right is "Motek". The two calves are not identified [photo credit: Boris Carmi, Tel-Aviv, Israel].



Figure 2. An overview of the African elephant enclosure at the Zoological Center, Ramat-Gan, Israel, in 1987 [photo credit: Zoological Center, Tel-Aviv Ramat-Gan].

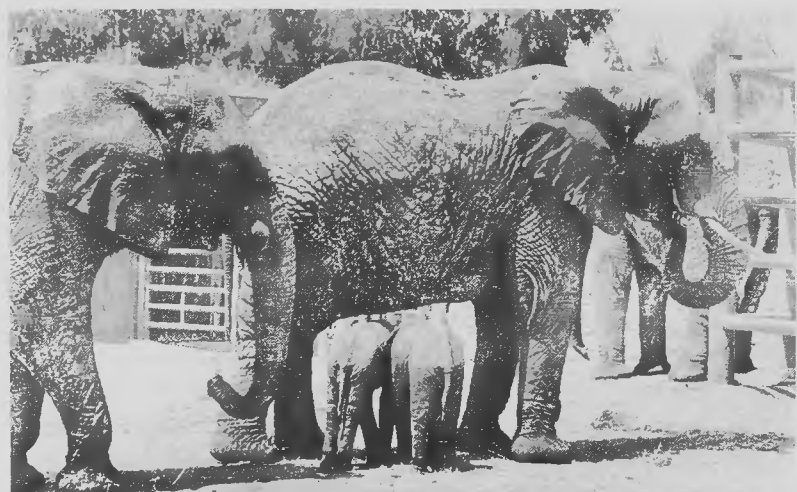


Figure 3. Female African elephants in the "Safari"; in the center is "Katerina" with her own calf, "Tami", and adopted calf, "Helinka" in 1987 [photo credit: Zoological Center, Tel-Aviv Ramat-Gan].

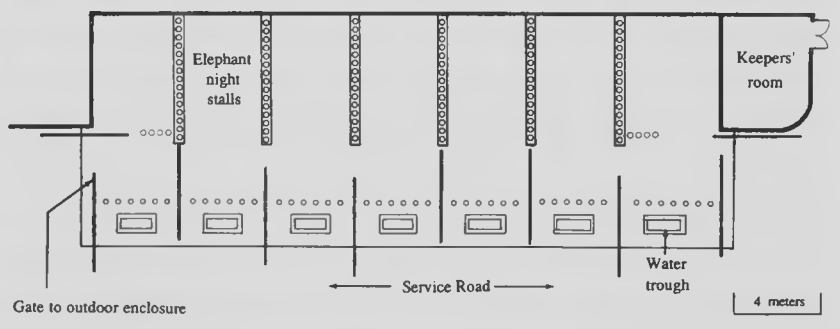


Figure 4. Drawing of the African elephant night quarters at the Zoological Center [artwork: Jann S. Grimes].

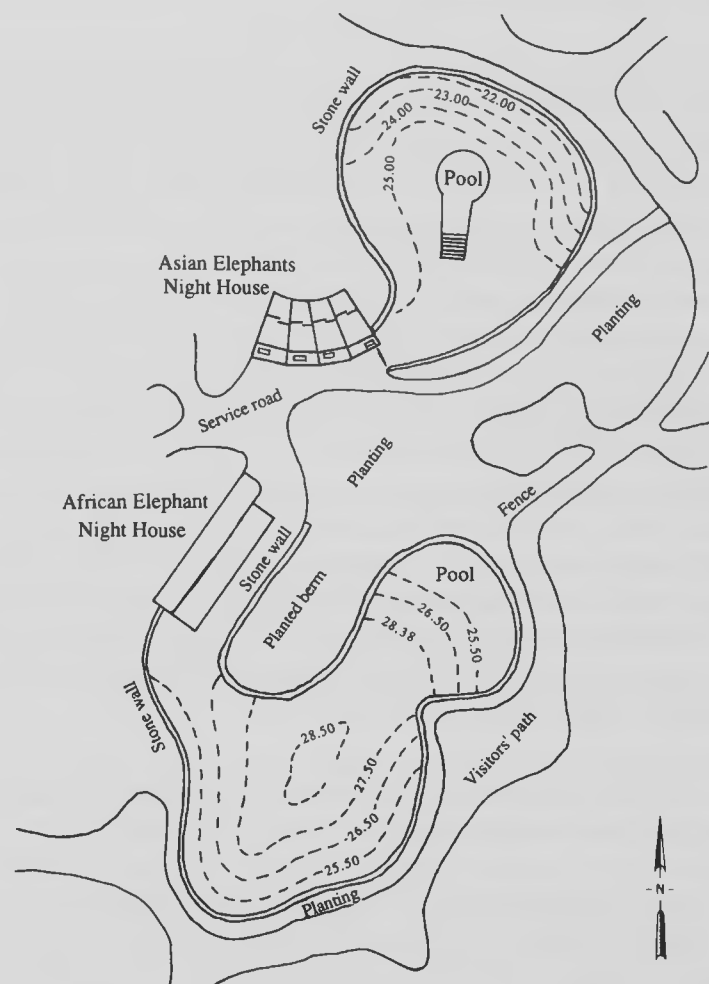
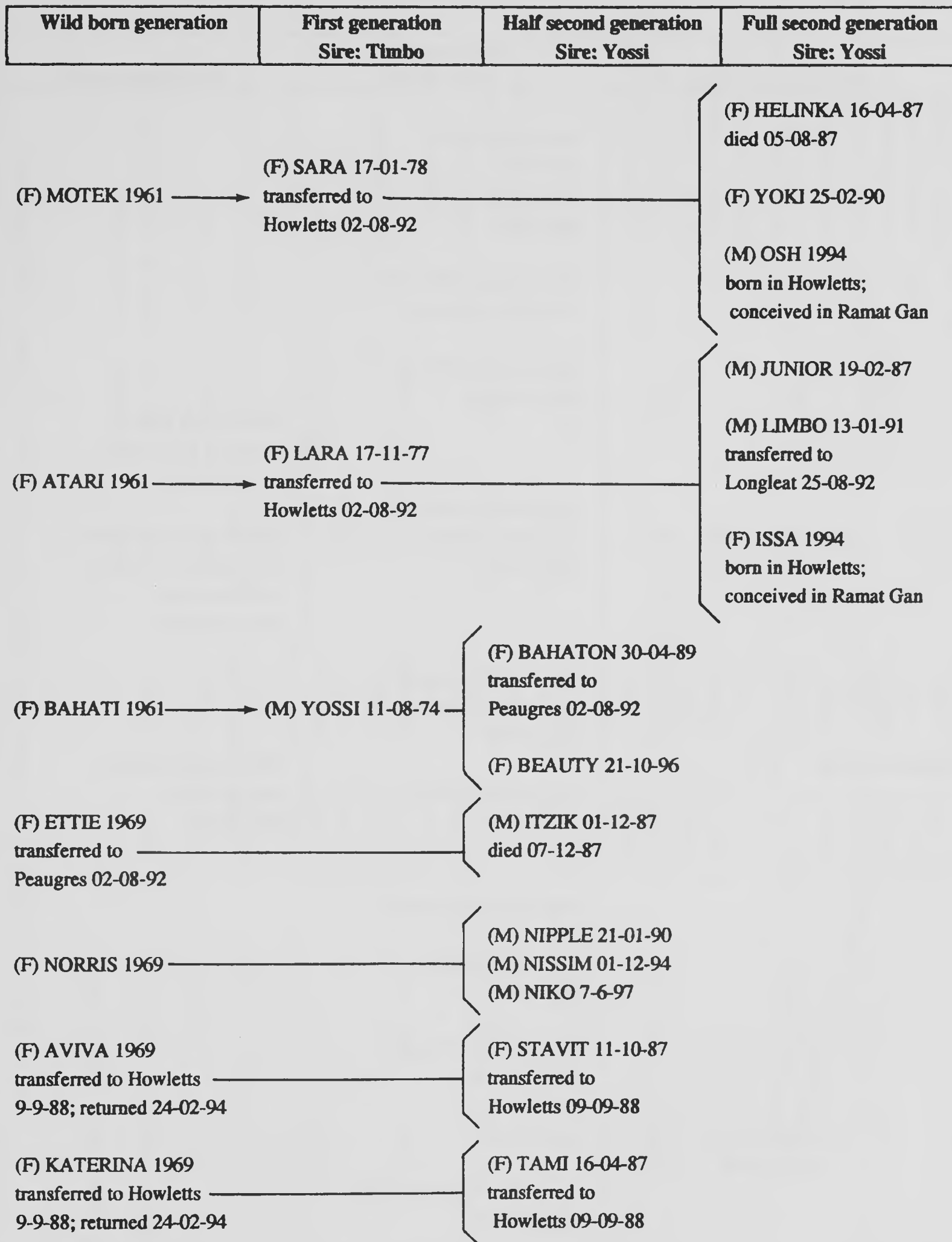


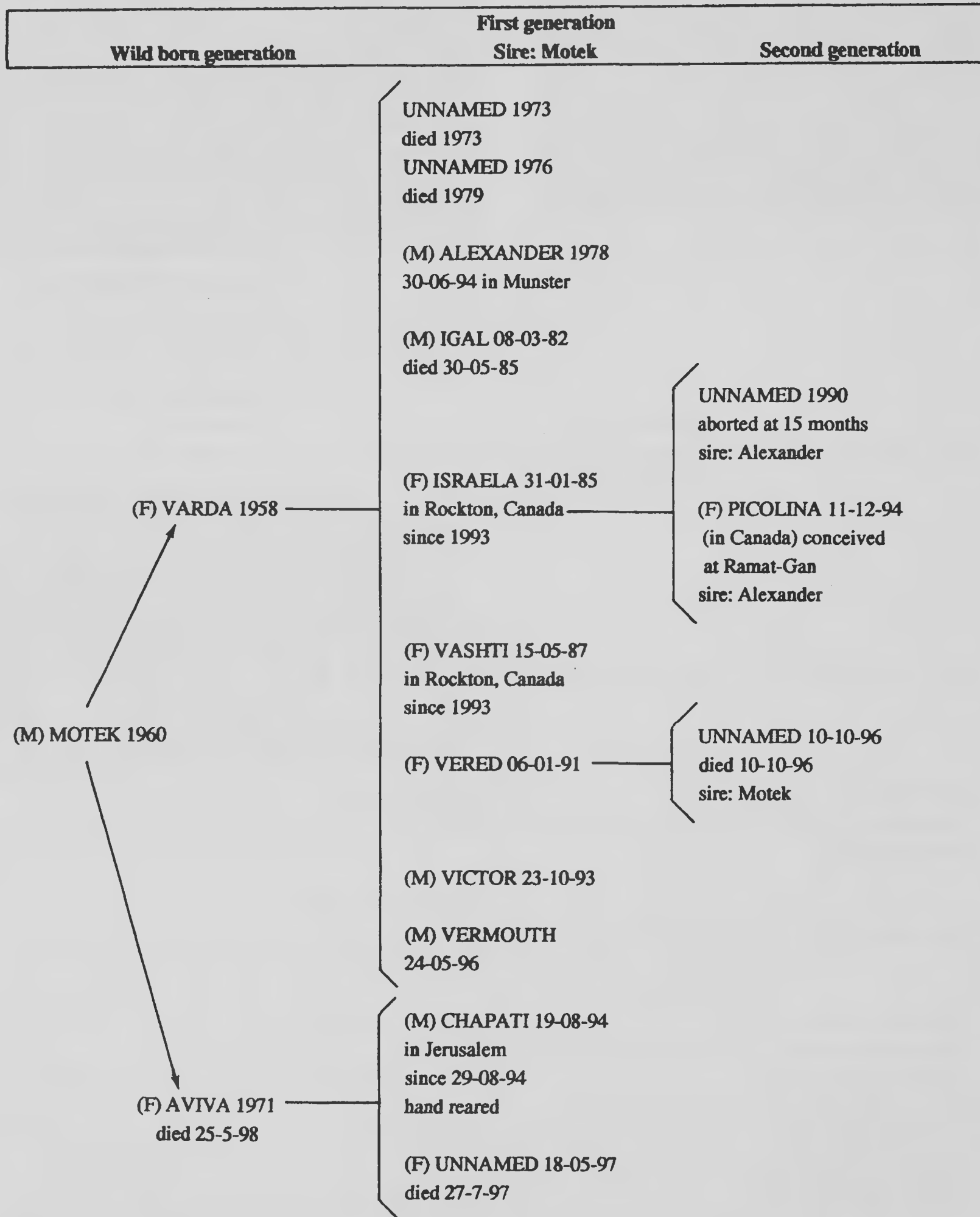
Figure 5. Drawing of the African elephant and Asian elephant facilities at the Zoological Center, Tel-Aviv Ramat-Gan [artwork: Jann S. Grimes].

Table 1. African Elephants Family Tree at the Zoological Center, Tel Aviv-Ramat Gan, Israel



Note: Data in this table may be compared to information in Table 3. Dates are written as: day-month-year (all years are 19--).

Table 2. Asian elephants Family Tree of at the Zoological Center, Tel Aviv-Ramat Gan, Israel



Note: Data in this table may be compared to information in Table 3. Dates are written as: day-month-year (all years are 19--).

Table 3

Table 3. History of the elephants, Tel-Aviv/Ramat Gan Zoological Center, as of August 18, 1998, with two updated entries.

Part I — Asian elephant, <i>Elephas maximus</i>								
ISIS Number (1)	Name	Sex/Age (2)	Date	Terms	Origin/ party	Dam/Sire their ID	Gestation period (5)	Notes / cause of death
650010	Motek	M / 38y, 7m, 26d	1 Jan 1960	wild born	India	NA	NA	none
			1 Jan 1962	donation from	M. R. Wilkes			
650011	Varda	F / 40y, 7m, 26d	1 Jan 1958	wild born	Singapore	NA	NA	none
			1 Jan 1961	from wild				
730016	unnamed	U / 0d	1 Jan 1973	captive born		Varda/Motek		none
			1 Jan 1973	birth			sex unknown	
			1 Jan 1973	death			died shortly after birth	
760010	unnamed	U / 3y, 0m, 1d	1 Jan 1976	captive born		Varda/Motek		
			1 Jan 1976	birth			sex unknown	
			1 Jan 1979	death			cause unknown	
780011	Alexander	M / 20y, 7m, 21d	1 Jan 1978	captive born	Tel-Aviv Zoo	Varda/Motek		has bred two females in
			1 Jan 1978	birth			Münster Zoo, Germany	
			30 Jun 1994	loan to	Münster Zoo			
820010	Igal	M / 3y, 2m, 23d	8 Mar 1982	captive born	ZCRG (3)	Varda/Motek		none
			8 Mar 1982	birth				
			30 May 1985	death			coli septicemia, oral infection	
850010	Israela	F / 10y, 3m, 21d	31 Jan 1985	captive born	ZCRG	Varda/Motek		conceived at ZCRG, gave birth in
			31 Jan 1985	birth			ALS (4). 1990 aborted at 15	
			21 May 1987	sold to	ALS (4)		months, sire: Alexander; sex unknown; 1994 birth in Canada mated with Alexander at ZCRG.	
870016	Vashti	F / 8y, 0m, 8d	15 May 1987	captive born	ZCRG	Varda/Motek		conceived at RGC, gave
			15 May 1987	birth			birth in ALS (4)	
			21 May 1993	sold to	ALS		miscarried the fetus (6)	
900037	unnamed	F / 0d	5 Dec 1990	captive born		Israela/Alexander		dam conceived at the age
			5 Dec 1990	birth			15+ m of about 4 1/2 years	
			5 Dec 1990	death			aborted at 15 months	
910019	Vered (also Wered)	F / 7y, 7m, 13d	6 Jan 1991	captive born		Varda/Motek		born during the Persian
			6 Jan 1991	birth			Gulf War	

Table 3 - continued

920020	Aviva	F / 27y	24 Mar 1971 18 Mar 1992 25 May 1998	captive born loan from death	Thailand Jerusalem	unknown		gave birth to Chapati (Ihie), 1984 and to unnamed, 1997 unknown
930028	Viktor	M / 4y, 9m, 26d	23 Oct 1993 23 Oct 1993	captive born birth		Varda/Motek		
940028	Chapati or Ihie	M / 10d	19 Aug 1994 19 Aug 1994 29 Aug 1994	captive born birth donation to	Jerusalem	Aviva/Motek		rejected by Aviva, bottlefed using Emmen Zoo formula
960068	Vermouth	M / 2m, 25d	24 May 1996 24 May 1996	captive born birth		Varda/Motek		Varda's 9th calf
960070	unnamed	F	10 Oct 1996 10 Oct 1996	birth death		Vered/Motek		dam conceived at 3 1/2 years, full term, 70 kgs
- - -	unnamed	F	18 May 1997 27 July 1997	birth death		Aviva/Motek		
Part II — African elephant, <i>Loxodonta africana</i>								
640010	Timbo	M / 17y, 4m, 4d	1 Jan 1961 1 Jan 1964 3 May 1978	wild born from wild death	Arusha, Tanzania	NA	NA	offspring: Lara (F), dam: Atari; Sara (F), dam: Motek; Yossi (M), dam: Bahati. Death due to stomach ulcer.
640011	Motek	F / 37y, 7m, 25d	1 Jan 1961 1 Jan 1964	wild born from wild	Arusha, Tanzania	NA	NA	daughter-Sarah
640012	Atari	F / 37y, 7m, 25d	1 Jan 1961 1 Jan 1964	wild born from wild	Arusha, Tanzania	NA	NA	daughter-Lara
690013	Bahati	F / 37y, 7m, 25d	1 Jan 1961 1 Jan 1964	wild born from wild	Arusha, Tanzania	NA	NA	son-Yossi; gave birth to Bahaton in 1989, and Beauty in 1996
690014	Sophie	F / 9y, 3m, 29d	1 Jan 1969 27 July 1973 29 Apr 1978	wild born from wild death	Arusha, Tanzania	NA	NA	not recorded in Table 1 stomach ulcer
730010	Putzi	F / 13y, 8m, 25d	1 Jan 1971 1 Jan 1981 23 Sep 1982	wild born donation from sold to	Tanzania Tel Aviv Petah-Tikva, Israel	NA	NA	not recorded in Table 1 died — 1985 or 1986
730011	Ettie	F / 25y, 7m, 6d	1 Jan 1969 27 July 1973 2 Aug 1992	wild born from wild sold to	Arusha, Tanzania SdP (7)	NA	NA	son-Izik, died 7 December 1987

Table 3 - continued

730012	Aviva	F / 29y, 7m, 23d	1 Jan 1969 27 July 1973 9 Sep 1988 24 Feb 1994	wild born from wild sold to trade from	Arusha, Tanzania Howletts Howletts	NA 	NA 	daughter-Stavit transferred from Howletts 9 Sep. 1988 returned to ZCRG 24 Feb. 1994
730013	Norris	F / 29y, 7m, 23d	1 Jan 1969 27 July 1973	wild born from wild	Arusha, Tanzania	NA	NA	formerly named Mazal sons - Nipple, Nissim, and Niko
730014	Katerina	F / 29y, 7m, 23d	1 Jan 1969 27 July 1973 9 Sep 1988 24 Feb 1994	wild born from wild sold to trade from	Arusha, Tanzania Howletts Howletts	NA	NA	daughter - Tami transferred from Howletts 9 Sep. 1988 returned to ZCRG 24 Feb. 1994
730015	Tali	F / 17y, 9m, 11d	1 Jan 1969 27 July 1973 9 Oct 1986	wild born from wild death	Arusha, Tanzania	NA	NA	not recorded in Table 1 anesthesia related
740010	Yossi	M / 24y, 0m, 13d	11 Aug 1974 11 Aug 1974	captive born birth	ZCRG	Baha.i/Timbo		daughter - Bahaton daughter - Beauty
770010	Lara	F / 18y, 3m, 18d	17 Nov 1977 17 Nov 1977 2 Mar 1994	captive born birth traded to	ZCRG Howletts	Atari/Timbo		transferred to Howletts 2 Aug. 1992 sons - Junior and Limbo daughter - Issa
780010	Sara	F / 18y, 1m, 18d	17 Jan 1978 17 Jan 1978 2 Mar 1994	captive born birth traded to	ZCRG Howletts	Motek/Timbo		transferred to Howletts 2 Aug. 1992 daughters - Helinka and Yoki son - Osh
870011	Junior	M / 7y, 5m, 14d	19 Feb 1987 19 Feb 1987 2 Mar 1992	captive born birth sold to	ZCRG SdP	Lara/Yossi		
870012	Tami	F / 3y, 4m, 25d	16 Apr 1987 16 Apr 1987 9 Sep 1988	captive born birth sold to	ZCRG Howletts	Katerina/Yossi		transferred to Howletts Zoo, England 9 September 1988
870013	Helinka	F / 3m, 20d	16 Apr 1987 16 Apr 1987 5 Aug 1987	captive born birth death	ZCRG	Sara/Yossi		heart pathology
870014	Stavit	F / 10m, 30d	11 Oct 1987 11 Oct 1987 9 Sep 1988	captive born birth sold to	ZCRG Howletts	Aviva/Yossi		transferred to Howletts 9 Sep. 1988
870015	Izik	M / 0y, 0m, 7d	1 Dec 1987 1 Dec 1987 7 Dec 1987	captive born birth death	ZCRG	Ettie/Yossi		accidentally crushed by Asians

Table 3 - continued

890015	Bahaton	F / 5y, 3m, 4d	30 Apr 1989 30 Apr 1989 2 Aug 1992	captive born birth sold to	SdP	Bahati/Yossi	transferred to SdP 9 September 1988
900014	Nipple	M / 8y, 6m, 29d	21 Jan 1990 21 Jan 1990	captive born birth		Norris/Yossi	transferred to Nikolaev, Ukraine, 8 June 1997
900015	Yoki	F / 8y, 5m, 24d	25 Feb 1990 25 Feb 1990	captive born birth		Sara/Yossi	
910020	Limbo	M / 3y, 7m, 12d	13 Jan 1991 13 Jan 1991 25 Aug 1992	captive born birth sold to	Longleat	Lara/Yossi	transferred to Lions of Longleat (near Bath, England) 9 September 1988
940027	Nissim	M / 3y, 8m, 18d	1 Dec 1994 1 Dec 1994	captive born birth		Norris/Yossi	
960071	Beauty	F	21 Oct 1996 21 Oct 1996	captive born birth		Bahati/Yossi	22 months
970	Niko	M	7 June 1997 7 June 1997	captive born birth		Norris/Yossi	
9	Unnamed	U / 0d	Unknown	captive born birth death		Yoki/Yossi	sex unknown died on day of birth cause unknown
---	Osh	M	1994	captive born birth	Howletts	Sara/Yossi	conceived in ZCRG, born in Howletts
---	Issa	F	1994	captive born birth	Howletts	Lara/Yossi	conceived in ZCRG, born in Howletts Zoo, England

Footnotes

- (1). ISIS=International Species Inventory System.
- (2). F=female, M=male, U=unknown, y=year(s), m=month(s), d=day(s).
- (3). ZCRG=Zoological Center Tel Aviv-Ramat Gan, Israel.
- (4). ALS=African Lion Safari, Cambridge (Rockton), Ontario, Canada.
- (5). Given in months and days. NA=Not applicable.
- (6). Fetus is now in the possession of the Elephant Research Foundation, courtesy of Mr. Charlie Gray.
- (7). SdP=Safari de Peaugres, Peaugres, France.
- (8). Summary for the African elephant — total currently housed at the ZCRG is 11 elephants (5 captive-born, 6 wild-born).

They include: Atari, Aviva, Bahati, Beauty, Katerina, Motek, Niko, Nissim, Norris, Yoki, and Yossi. Added in proof: Beauty and Nissim were sold to Knowsley

Safari Park, England, November 28, 1998. A male calf was born to Norris (not yet named), September 30, 1999.

- (9). Summary for the Asian elephant — total currently housed at the ZCRG is 5 elephants (3 captive-born, 2 wild-born): Motek, Varda, Vered, Vermouth, Victor.

would occur. On the morning of February 19, 1987, we were delighted to find a new baby male. Junior was born to Lara and Yossi, themselves both born in Ramat-Gan; thus Junior is a second generation Ramat-Ganian. Lara, age 10, was just a youngster herself, a "teenage mother at risk". Upon the arrival of the baby she was quite distraught and pushed the baby away through the bars to her own mother, Atari, housed in a separate night stall adjacent to hers. Atari pulled Junior to herself, amidst much trumpeting and agitation. She appeared to want to mother the baby, or perhaps to "teach" her daughter how to care for it. For several hours Atari nudged the baby persistently with her trunk, and gently rubbed parts of its body with the bottom of her foot; she prodded him and used her trunk to blow air all around his neck and ears, perhaps trying to keep him awake and get him to stand up. Finally she succeeded and during the first two days, constantly stimulated him so that he would not lie down. We saw this "stimulating" behavior repeated in subsequent births. Meanwhile, Lara paced back and forth in her adjacent stall, and after a few hours appeared to have a change of heart. She tried to slither under the bars to reach her baby, and when she did not succeed she tried to climb over the top. There is nothing funnier than an elephant trying to squeeze through an opening obviously inappropriate to its size. In spite of the comic aspects of her gymnastics, we were all amazed at the flexibility of her body.

When Lara showed positive contact with Junior through the bars, the keepers united her with the baby, but she persistently attacked him. Finally the keepers reunited grandmother, mother and grandson in one stall and Lara calmed down and cared for her baby. During the first two days, it appeared as though Atari (the grandmother) was teaching Lara how to care for the baby; she even got Junior to nurse from Lara. The relationship of the two adult females was amicable until the third day when Lara violently kicked Atari out of the stall (cf. Dublin, 1983), apparently wanting the baby all to herself. The new baby weighed in at 85 kilograms and during examination, Dr. Motke Levison, the zoo vet, noticed an umbilical cord infection, and so for Junior's first two weeks he was handled and treated regularly. This regular handling made Junior very friendly with the staff and later he initiated play with his keepers. Lara and Junior joined the rest of the herd, all of whom snuffled him, inspecting, touching, and embracing him with their trunks, and sheltering him from the hot sun with their bodies. All showed interest in him, just as might be seen in a wild herd in Africa (Sikes, 1971; Douglas-Hamilton and Douglas-Hamilton, 1975; Moss, 1988).

Junior's appearance made great news and the elephant keepers were happy. But imagine our surprise when on arrival at work on April 4, we found two more baby elephants! We knew that more females were in late pregnancy, but it was totally unexpected to have two mothers give birth on the same day. In looking for a scientific explanation for this statistically unlikely event, two things had to be synchronous - first, the females would have had to come into estrous cycle (which occurs about every four months) and estrus, or in heat (which lasts for a few days; cf. Hess *et al.*, 1983; Schmidt, 1992) at approximately the same time, twenty-two months earlier, possibly stimulated by the new odors of the newly sexually active male, and second, onset of labor had to be more or less synchronous. Again, possibly the smells, sounds and visual stimulus of one elephant's labor may have initiated the process of the second one (cf. Poole, 1987), a phenomenon known in other mammals (McClintock, 1983). Since the births occurred before the keepers arrived in the morning, it was not clear which elephant delivered first, but both occurred within less than six hours of each other, judging by the condition of the placentae.

The two mothers reacted differently to their offspring. Sara, aged nine, was another teenage mother like Lara; she gave birth to Helinka in a stall which she shared with her mother Motek. Motek is the second largest and the dominant female in the herd. Motek actually took over the baby and physically prevented Sara from approaching the calf by pushing her away with her trunk. Motek kept the baby close to herself and tried to get her to nurse from her nipples, but of course she had no milk. Since Sara could not approach the calf, she did not receive the stimulation to produce milk and within about a week she seemed to have lost interest in her calf. Although we saw the situation developing, we did not have sufficient stalls to separate Motek and Sara, and let Sara develop her maternal interest in Helinka. The well-being of this calf thus presented a real problem, but the elephants provided their own solution, as will be discussed below.

The third mother, Katerina, on the other hand, was slightly older and larger than Lara and Sara. She is from the second group of wild-born females, and had a stall to herself. She seemed to mother quite naturally from the beginning. But her calf, Tami, was born with an inturned hind foot, and could not balance and stand properly. Our vet, Dr. Levison, placed the leg in a cast for 10 days. This, in itself, was quite a feat. It took three people to hold the baby down each time the cast had to be changed every 3 days. As a result of this handling, Tami became very tame, like Junior, and willingly slipped through the bars to visit the keepers.

The solution — adoption. Meanwhile, it was natural for Sara's hungry calf, Helinka, to bleat and cry while looking elsewhere for milk. Unlike the mature elephants, the calves could wander from stall to stall by creeping between the bars, and also had access to all herd members during the day when all of them were outdoors. Katerina willingly accepted her calf Tami to nurse. Soon, Helinka found Katerina nursing Tami, and within a short time Katerina adopted Helinka fully. The keepers encouraged the adoption by separating Sara from her baby. Now Katerina could be seen standing quietly with both calves nursing simultaneously (Fig. 3; cf. Terkel and Epstein, 1989).

The fact of adopting a second calf meant Katerina had to produce much more milk. If she produced about six liters for one calf during the first few days (Douglas-Hamilton and Douglas-Hamilton, 1975), she must now produce more than an estimated 25 liters of milk daily for the two-month old calves! Since the babies were quite thin, the keepers tried to get them to drink powdered milk. First Yankele Sapania, the keeper, dipped his hand in the warm milk and got the calf to suck on his hand, planning to transfer the sucking behavior later to an enormous two liter nursing bottle. But, although the calves sucked his hand, they did not go for the bottle; they clearly preferred mother's milk. Furthermore, Katerina, herself, became very wary and used her trunk to keep the calves from approaching Yankele for a drink. In August at the age of four months, Helinka, the adopted calf clearly waned and then died. Post mortem revealed that she was undernourished, and that the blood vessel leading from the heart to the lung had not opened properly. Although the milk composition in elephants is nourishing (Markuze, 1939; McCullagh *et al.*, 1969; Peters *et al.*, 1972; and Mainka *et al.*, 1994), the amount probably was not sufficient for two calves.

Other births and deaths. While the keepers were recovering from the loss of this calf, Aviva gave birth to a nice female calf, Staviv. Aviva, too, was a good mother, and helped the calf stay awake during its first hours, stimulating it with her trunk and her feet to get it to rise to its feet.

The last birth in 1987, another male calf (Izik), looked handsome and healthy. But his mother, Ettie, simply did not stand properly in order to help him reach the nipple. She should have extended the foreleg forward, but failed to do so. The calf was successfully bottle fed for a few days (cf. Sheldrick, 1992), but one night he wandered out of the night stall over to the Asian elephant enclosure. This was his undoing and we found him crushed in the morning.

Since the memorable year of 1987, there have been a few more changes in our African herd. Aviva (meaning "Spring") and her daughter Stavit (meaning "Fall") and Katerina and her daughter Tami were shipped to Howletts Zoo in England, where a large breeding herd, including two bulls, has been established. Another female calf, Bahaton, was born in April 1989, this time to Bahati. Bahati's next calf was born in 1996. Norris has delivered three bull calves, Nipple, Nissim, and Niko.

In 1994, Aviva and Katerina returned to Ramat Gan from their six-year sojourn in Howletts Zoo, England, while Lara and Sara, both pregnant, were sent to Howletts. The reason for these moves was to prevent further breeding between Yossi and his full and half sisters, Lara and Sara. We thought the return of two familiar females to the group — Aviva and Katerina — was unlikely to present social problems and we could continue breeding with these unrelated wild-born females.

Certainly the returning female elephants recognized their old companions and vice versa and there was much sniffing and touching around the musth glands among the females. No aggressive blows were seen.

But Yossi, it seems, had a different opinion. He took an extreme dislike to Katerina, to the point of being violent, and injuring her rump, and Aviva is simply ignored. So, now Katerina and Yossi are never outdoors at the same time.

We did not predict this outcome, but it shows that management decisions based both on behavioral considerations and genetic considerations do not always succeed.

BREEDING BEHAVIORS AMONG ASIAN ELEPHANTS, *ELEPHAS MAXIMUS*

During all the excitement surrounding these African calves, everyone noticed Varda, the Asian female, getting heavier and heavier. Her belly looked as if it would soon touch the ground. On May 15, 1987, she delivered an absolutely immense female calf, Vashti (cf. Table 2). Although we did not actually weigh Vashti, we easily estimated that she weighed 120 kilograms. Vashti shared the enclosure with her two and one-half-year old sister, Israela, and a brother, Alexander, aged 10, as well as her parents. Varda is a very experienced mother, having had five calves at the time Vashti was born. We noticed that Vashti was much stronger and more coordinated than her African age mates. She was able to use her trunk to put things in her mouth at the age of three weeks, while the oldest African at age 4 months still was not performing this behavior. Vashti's older brother and sister play with her, and they all bathe in their pool. Motek, the father, is gentle with the newly born calf, although, in general, the mother keeps her away from him.

DISCUSSION AND SUMMARY

General comments. Many zoological institutions do not keep large herds of African and Asian elephants. Partly, this is due to space

limitations. Furthermore, elephants are expensive to keep, since they eat an enormous amount of food (about 75-150 kg or 165-330 lbs per elephant; Eltringham, 1992), and require a relatively large amount of manpower to feed and clean them. Most zoos do not keep bulls, since they are dangerous, particularly when they enter a state called musth (which occurs in both Asian and African elephants — e.g., Poole, 1987; Poole and Moss, 1981; Schmidt, 1992). Musth is a condition recognized by the swelling of the temporal gland (located under the skin midway between the eye and the ear) and an oily secretion from this gland, often associated with erratic and aggressive behavior, believed to be manifested more in the Asian species. As a result of keeping few Asian bulls in captivity, there have been fewer calves sired in proportion to the captive population.

World-wide reported live captive births of Asian elephants in 1987 were seven, while for 1992 and 1993 (International Zoo Yearbook), 4.4 and 3.3, respectively. World-wide births of African elephants in 1987 were five (all in Ramat Gan) and for 1992 and 1993, only 2.0 total.

It was certainly an unusual situation that one facility had five African elephants born in one year (1987) and other zoos — to the best of our knowledge — had none. This fact may have skewed the annual statistics on captive births. As for the Asian elephants, of the 11 known births for 1987, 7 were in North America, 3 in Europe, and 1 in Israel (cf. Schweiger, 1993; Shoshani, 1987).

Birth intervals. Concerning birth intervals, a close examination of Table 2 reveals that Varda (38 year old female Asian) had nine calves sired by Motek (36 years old) over a period of 23 years, from 1973 to 1996. Varda's first calf was born when she was 15 years old, and at that time, Motek was 13. Of the nine calves, three died, three were sold or loaned, and three are still with Varda. The calculated birth interval, therefore, is 2.5 (23 divided by 9). This birth interval is low compared to the average of four years for African and Asian elephants in the wild (Laws *et al.*, 1975; Sukumar, 1989).

Unusually young age at conception. In the wild, cow elephants conceive at about 10 to 12 years of age (Moss, 1988; Sukumar, 1989). With two exceptions, our females gave birth when they were 9-21 years old, the average being 15. The exceptions were Israela (and Vered, Asian), both of which apparently conceived at the age of about 4 1/2 and 3 1/2 years, respectively — the sire was brother Alexander in the first case and Motek in the second.

The morning of January 6, 1991, the elephant staff was astonished to find the crushed carcass of a fetus in Israela's stall. The fetus had been thoroughly flattened and its internal organs expressed. The crushed fetus weighed approximately 46 kg without all the internal organs, and externally gave the impression of being more than 15 months developed. It was not possible at the time to determine its sex; later it was determined to be a female. The placenta was torn and it was impossible to determine if it was complete.

Judging by the size and development of the fetus, and by the keeper's behavioral observations, Israela must have conceived in mid-1989, at the age of 4 1/2 years. This is surely one of the youngest conceptions known for an Asian elephant. At the time of the miscarriage, Israela was 2.37 meters tall at the shoulder and 1.4 m chest to rump length, estimated weight approximately 2 metric tons. A number of possibilities leading to the miscarriage remain open: Israela's immaturity, anticipated problems with a first pregnancy, as well as unexplained illness in 1990. In October 1996, Vered gave birth to a fully formed viable female calf weighing 70 kg. She was 5 years,

9 months at the time of delivery. The baby was found dead from traumatic injuries on the day of birth. Varda, the grandmother, was seen pushing it and hitting it aggressively. At the Paris Zoo, a similar aged Asian elephant gave birth and the baby survived (Claude Renvoisé, personal communication).

Behavioral observations. One Asian elephant calf (Vashti) appeared to be more coordinated than her African age mates, as she used her trunk at the age of three weeks to place objects into her mouth, whereas the four month old Africans were not observed to do this. An interesting observation concerning young calves and grandmothers was noted when, on two occasions, the grandmother "protected" the grandchild and prevented the mother from coming close to it. One pair was Atari and Junior, and the other pair was Motek and Helinka (all African elephants). Another observation of interest was when the older females in the African herd "helped" Yossi, the bull, to mate with the younger cows by "trapping" them from the front so Yossi could mount them.

A concluding thought. Since the number of wild African and Asian elephants has been severely reduced in recent years (cf. Douglas-Hamilton, 1992; Sukumar, 1989; Sukumar and Santiapillai, 1996), the Zoological Center is one of several institutions contributing to the breeding of these species. These tidings are especially welcome since both species of elephants are now listed as Endangered Species in Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) due to habitat fragmentation and poaching.

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