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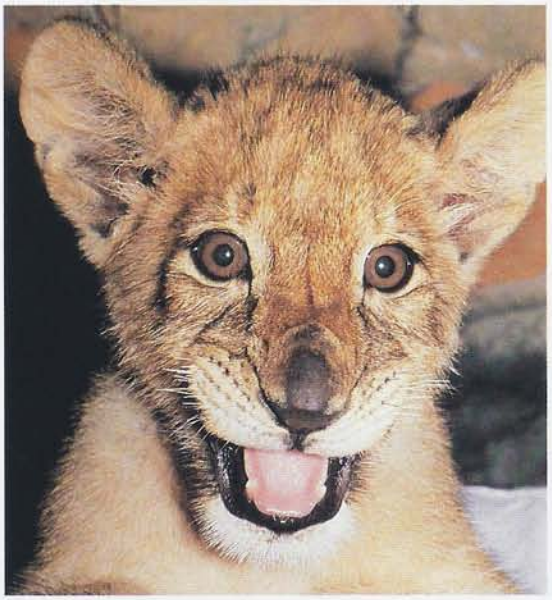
THERE'S A REPRODUCTIVE REVOLUTION TAKING PLACE AT THE CINCINNATI ZOO

Are You My MOTHER?

BY SHARON ELAINE THOMPSON

Sometime in the near future a bongo (*Tragelaphus euryceros*) may browse quietly in the sun-dappled forests of Kenya while half a world away, in the snow drifts of the Cincinnati Zoo, an eland (*Tragelaphus oryx*) may be delivering the bongo's calf. This biological sleight of hand will be accomplished by embryo transfer, a process that takes fertilized eggs, or embryos, from one female and places them into the uterus of another. This interspecies scenario may sound like science fiction, but the technique has been tried — with success.



NANCY STALEY/COLUMBUS ZOO

The concept of embryo transfer is not new, nor was it devised by man. To stretch the point a bit, several species of birds — notably European cuckoos and cowbirds — perform this procedure when they deposit their eggs (hard-shelled embryos) in nests (a kind of primitive, external uterus) of other unsuspecting birds. However, the eggs of most mammals are carried to term in the mother's body and are not so easily shifted.

The first successful transfer between mammals was made in 1890 by Walter Heape of Cambridge University, who transferred embryos from one rabbit to another. Since the 1930s, the technique has become widely used in farm animals, especially dairy and beef cattle. In 1988 alone, approximately 60,000 calves in the United States were born from embryo transfers. This procedure is possible because mammals, as a kind of survival insurance, produce many thousands more eggs than they will ever use.

Researchers realized this natural abundance could offer an excellent way to propagate certain endangered mammals. Through embryo transfer, an animal could have far more offspring than she would be able to produce naturally.

Although embryo-transfer techniques have been developed for cattle, exotic animals pose their own

Bongo calf with its surrogate mother, an eland, the happy result of a successful interspecies embryo transfer.

special problems. "[In] everything we do, there is just so little [information] on it. . . . We usually feel we're starting at ground zero," says Dr. Betsy Dresser, the Cincinnati Zoo's director of research. Dresser heads the Center for Reproduction of Endangered Wildlife (CREW).

CREW researches many aspects of exotic-animal reproductive physiology, such as artificial insemination, cryopreservation (preservation by freezing) of semen, embryos and eggs, and in vitro (in glass) fertilization. However, much of CREW's work is directed toward learning more about embryo transfer because of the procedure's tremendous potential.

One of a zoo's toughest challenges is to prevent inbreeding in its animals. In the wild, animals avoid inbreeding naturally through migration and mating habits, and by their sheer numbers. Because zoos house only a limited population of any given species, they must lend animals to one another to vary their gene pools. Embryo transfer could increase their options and their effectiveness.

Through embryo transfer, zoos could exchange animal bloodlines without the risk and expense of shipping the animals themselves. In fact, thousands of fertilized eggs with their precious genetic cargo, frozen and stored in liquid nitrogen, could be kept indefinitely. Embryo transfers between closely related species would allow the offspring of rare and endangered animals (such as the bongo) to be carried to term by a more common cousin (such as the eland). Also, embryos could be split in two, producing identical twins borne by different "surrogate mothers."

This technology could even mean that eggs from captive animals that die suddenly could be removed and frozen. Later those eggs could be fertilized in vitro and transferred into the uterus of a surrogate. And, finally, eggs could be collected from animals that will not mate, keeping their bloodlines alive thanks to cryogenics.

The procedure's potential as a hedge against extinction is particularly important to Dresser. Through embryo transfer, she explains, "You can literally keep a species from going extinct, provided you can thaw out the embryos and identify a surrogate, either of the same species or a closely related species. For me, if our program helps keep only three or four species from going extinct in my lifetime, it'll be worth it."

It may sound incredible, but Dresser and the CREW team have successfully performed all these techniques except the thawing and fertilizing of eggs in vitro. They are working on that project now.

The group's string of successes started in 1983 when it transferred the embryo of an eland into another eland. Later that year, at the Los Angeles Zoo, Dresser and Dr. Earle Pope flushed five embryos from a bongo. With the vials containing the "herd" taped under their arms to keep the embryos at a constant temperature, Dresser and Pope then rushed to the airport and returned to Cincinnati. (The embryos stay viable for only about 12 hours.) They were met at the airport and hurried to the zoo where five recipients — four eland and a bongo — were ready. The embryos were transferred and the team waited.

Two transfers "took," and in June 1984, the single bongo recipient and one eland surrogate each bore a bongo calf. Later that year, the bongo donor conceived naturally, thus producing in one year three offspring instead of her standard single calf.

All of this splitting, transferring and freezing has been a dress rehearsal for a project near to

CINCINNATI ZOO AND BOTANICAL GARDEN

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Dresser's heart. She has been working with Stefanie Powers and the William Holden Wildlife Foundation in Kenya on a plan to remove embryos from the bongo collection there. She plans to transfer them to the eland in Cincinnati. For years the U.S. government prohibited the importation of embryos for fear of hidden diseases. But by constant lobbying, Dresser finally demonstrated that disease transmission could be detected by isolating the surrogate and her calf and carefully monitoring their blood.

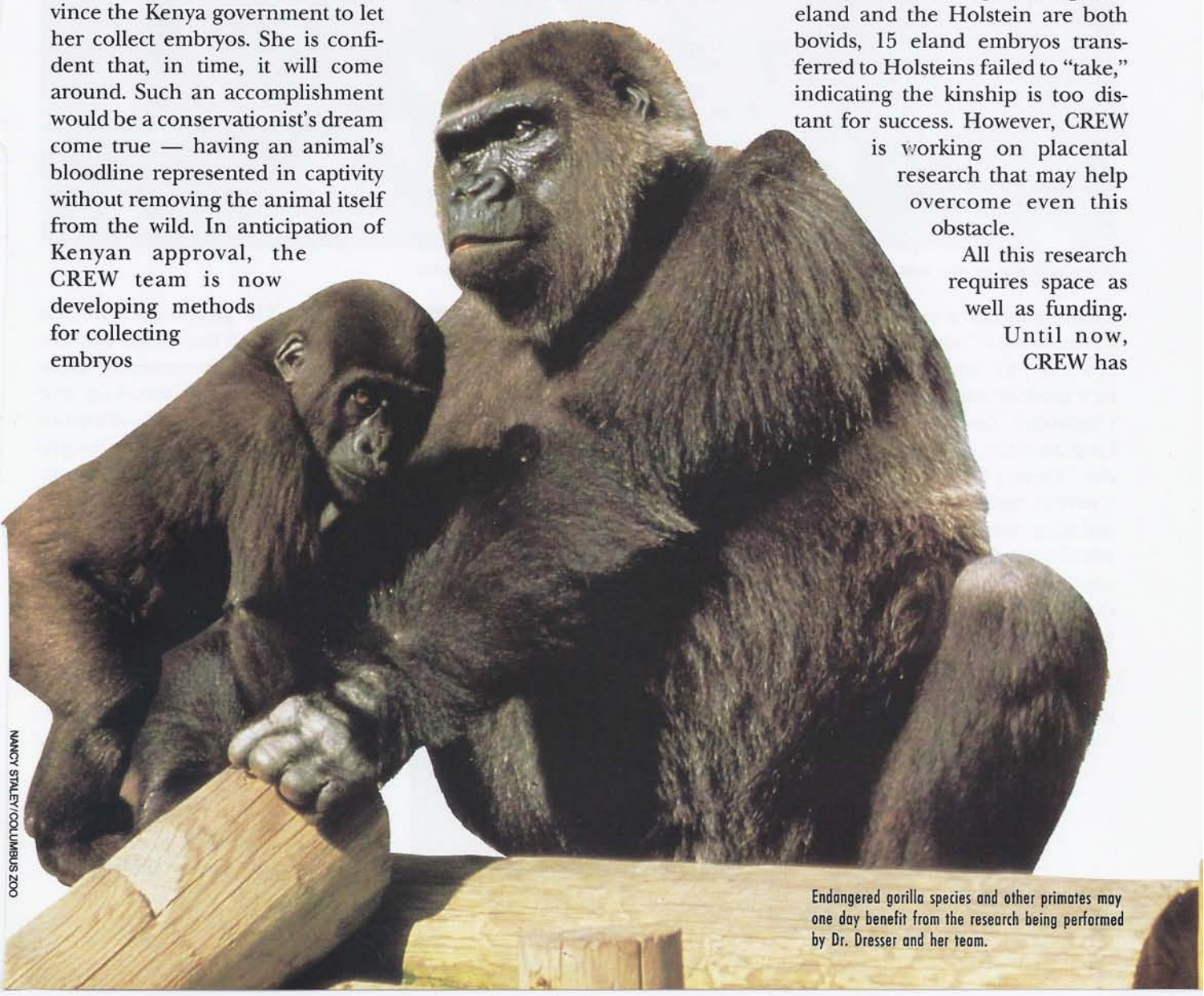
Now Dresser is trying to convince the Kenya government to let her collect embryos. She is confident that, in time, it will come around. Such an accomplishment would be a conservationist's dream come true — having an animal's bloodline represented in captivity without removing the animal itself from the wild. In anticipation of Kenyan approval, the CREW team is now developing methods for collecting embryos and freezing them in the field.

The work of CREW is not limited to the family Bovidae, which includes cattle, antelope and bison. It has had remarkable success with small cats as well. Starting in 1985, researchers produced a litter of domestic kittens using embryo transfer; later, a litter of frozen embryos was carried to term by a surrogate.

Finally, in 1989, a rare Indian desert cat (*Felis sylvestris ornata*), found only in one locale in Sri Lanka, was fertilized in vitro; the embryo was transferred to a domestic cat (*Felis catus*). The result was "Noah," the first in vitro fertilization and first embryo transfer between different cat species. This success gave Dresser and her team not only much-needed information for work with other small cats but a basis to build on for future work with tigers, leopards and snow leopards.

Dresser would also like to develop "universal surrogates," animals such as the Holstein and the domestic cat that can act as surrogates for a variety of exotics. But that may take a bit more embryonic tinkering. Although the eland and the Holstein are both bovids, 15 eland embryos transferred to Holsteins failed to "take," indicating the kinship is too distant for success. However, CREW is working on placental research that may help overcome even this obstacle.

All this research requires space as well as funding. Until now, CREW has



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Endangered gorilla species and other primates may one day benefit from the research being performed by Dr. Dresser and her team.

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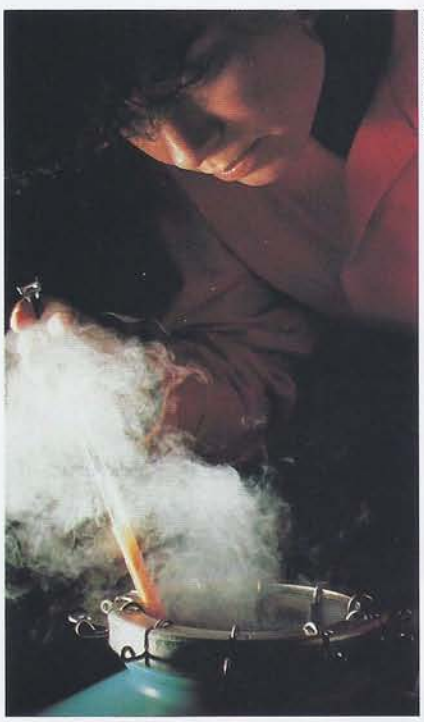
In vitro fertilization and other techniques are being perfected for future work with snow leopards and other big cats.

used the facilities at the University of Cincinnati College of Medicine. However, by the spring of 1991 its new facilities on the grounds of the Cincinnati Zoo should be ready. One attraction for visitors will be the "Frozen Zoo." Right now the compact tanks of liquid nitrogen holding future generations of wildlife and plants take up the space of a large closet. Two or three tanks could hold thousands of samples.

The CREW team has the technology it needs to succeed, and it is not the only group working in the field. The Bronx Zoo, the San Diego Zoo and the Dallas Zoo are also using embryo-transfer techniques. But understanding the reproductive physiology of exotics takes time, and many species are near extinction. Do scientists have the time they need to save them?

Says Betsy Dresser: "I have to think so, or I don't believe I would be doing this. There may not be time for all species. But I certainly think that if we really keep after it, there is time to do some things. . . . If you can just continue the momentum, along with this environmental awareness that's going on, I really believe we can make a difference." □



PETER C. POULIDES

Cincinnati's cryogenic facility, nicknamed the "Frozen Zoo," is used to freeze and store embryos and sperm from exotic animals including bongos and black rhinos.

Sharon Elaine Thompson is a free-lance writer based in Glendale, California.