EACH YEAR, conservation and research projects increasingly require the actual handling of wild animals. In game reserves and National Parks all over the African continent, chemical immobilisation of large mammals is becoming routine.

In this article, DR. ANTHONY HARTHOORN of the Department of Physiology, University College, Nairobi, considers modern chemical capture techniques.

Dr. Harthoorn, internationally-recognised as leading advanced research in this field says that chemical capture today causes little distress to animals and, with new drugs, the mortality percentage is now low.

LARGE ANIMAL RESTRAINT

A prerequisite for conservation and research

CAPTURE is becoming to be a recognised essential for the detailed study of the larger animals and particularly to ascertain growth and incremental rates, longevity, movement cycles and many of the behaviour patterns. It is difficult to imagine some conservation practices carried out without this basic knowledge.

It is also a means of moving animals out of areas in which they have become too numerous or returning them when they have inadvertantly strayed out of national parks.

Chemical capture has already been extensively used in place of shooting for disease diagnosis. It may be used to render assistance to animals hurt, or trapped, or to enable considered decision to be taken as to whether a wounded animal can survive.

Simple, safe and generally applicable, it is a certainty that it will be used increasingly to assist the conservation of African animals—both indirectly, as a means of gaining essential knowledge, and directly, to save animals and species through transporting and direct assistance.

Technique for chemical immobilisation of African hoofed animals has made rapid strides since its commencement in 1958 (*Buechner, Harthoorn and Lock,* 1960).

But progress in East Africa received a temporary set-back when it was found that the method evolved for kob antelope—and later applied with reasonable success to other antelope, zebra and buffalo—was quite unsuitable for larger animals, such as rhinoceros and elephant.

The reasons for the latter difficulty were not hard to ascertain.

The body-weight of the large animals is almost impossible to judge, within the limits necessary for the earlier compounds.

The build of large animals, too, militates against their lying on their sides for long periods and the length of time they can remain recumbent is greatly reduced when normal breathing and movements are restricted by the

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The late Game Warden Ukambani affixing an ear tag to an elephant he had immobilised with M.99. A considerable amount of knowledge is needed for the successful chemical capture of the large mammals and Mr. Chappell was able to show by his success that the technique could be mastered after several manths' training.

LARGE ANIMAL RESTRAINT

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influence of either centrally-acting or paralysing compounds.

If temporary respiratory paralysis should ensue, artificial respiration may be given to small antelope; but the large animals cannot be ventilated effectively and, usually, little more is achieved than that the "dead space"—that is, the air in the wind pipe and bronchi—is moved back and forth *without changing the lung air*.

Furthermore, large animals rely on chest movements to assist the return of veinous blood to the heart and tend to die rapidly, of circulatory collapse, when breathing ceases—even for a short while.

The problem of the capture of large mammals was tackled experimentally for the specific purpose of moving the Southern White (square-lipped) Rhinoceros. The animals are rare and highly valuable, but had increased—through careful management—in their sole remaining home in the southern hemisphere.

It was essential initially to move 10) of these animals, to obviate the danger of extermination from disease, or—in case of drought—starvation.

Experiments were carried out on domestic hoofed animals at the Department of Physiology of Nairobi's University College during 1960. Solution to the question was found by satisfying the requirements of an ideal "immobilising mixture."

Principally, the requirements were:

(*a*) a wide safety-margin;
(*b*) retention of normal body functions;
(*c*) availability of a rapidly-acting non-toxic antidote: and
(*d*) speedy action, at safe dosage rates.

THE SAFETY-MARGIN—that is, the difference between the lowest dose capable of immobilising the animal and the maximum tolerable amount that can be injected—is only about 20 per cent for some of the compounds used on antelope. Error in judging the weight of, say, an elephant may exceed this by several times that amount.

This means, in effect, that some animals would get away, wasting drug and syringe through receiving too little; others might be fatally over-dosed.

The retention of normal body functions, such as respiration, is highly important in the large animals. In fact, even the loss of "righting reflexes" is detrimental, as the animal may fall repeatedly, or else lie in a position in which breathing is hampered.

It was most desirable, therefore, that the animal should be immobilised while retaining its power of remaining upright on the brisket and, in other ways, keeping balance, with head and neck off the ground.

The sooner large animals can regain their feet, after immobilisation, the better will be their recovery. They must be restored to normal, or near-normal, condition as soon as feasibly possible after measurement or marking has been carried out.

The restraining compound to be used must be one which can be counteracted by an effective antidote.

The "reversal" of the capture-drug's effects greatly facilitates crating of animals prior to relocation. It is almost impossible to get a recumbent rhinoceros for instance, into a crate of size suitable for transport. Winching the roped animal onto a lorry causes avoidable distress, shock, and paralysis of the legs through pressure on the main nerve trunk is likely. But we found he could be induced to walk into the capture crate.

AT ordinary dosage rates, the compounds for capture should be quickly absorbed, so that the animal may be followed and the chances of losing him in rough country reduced. A formula closely approaching the ideal was found as a result of experimental work specifically directed to rhinoceros relocation.

The synthetic morphine compound *Themalon**—although by itself almost entirely ineffective for subduing hoofed animals—was found to be very effective when mixed with the right type of tranquiliser.

When Themalon was "reversed" with *Lethidrone***, the animal was found to be capable of rising to its feet in from 30 to 60 seconds.

So effective did this combination prove to be that, with its use, well over 100 of the Southern White (square-lipped) Rhinoceros were immobilised and moved under the expert supervision of Mr. Ian Player, then senior warden at Umfolosi Game Reserve. Not a single loss due to failure of recovery from the immobilising dose occurred.

This mixture—to which a small amount of *scopolamine* was usually added, complied with the criteria of an "ideal immobiliser" in all but the last respect—that of rapid absorption.

The difference between the smallest and largest dose used was eight-fold (or 800 per cent), thus obviating the need for accurate weight estimation. Breathing was almost unaffected and many of the animals, actually remaining on their feet, could be caught while standing, or walking.

If they did go down, an intravenous injection of *Lethidrone* nearly always brought them to their feet again, in less than a minute.

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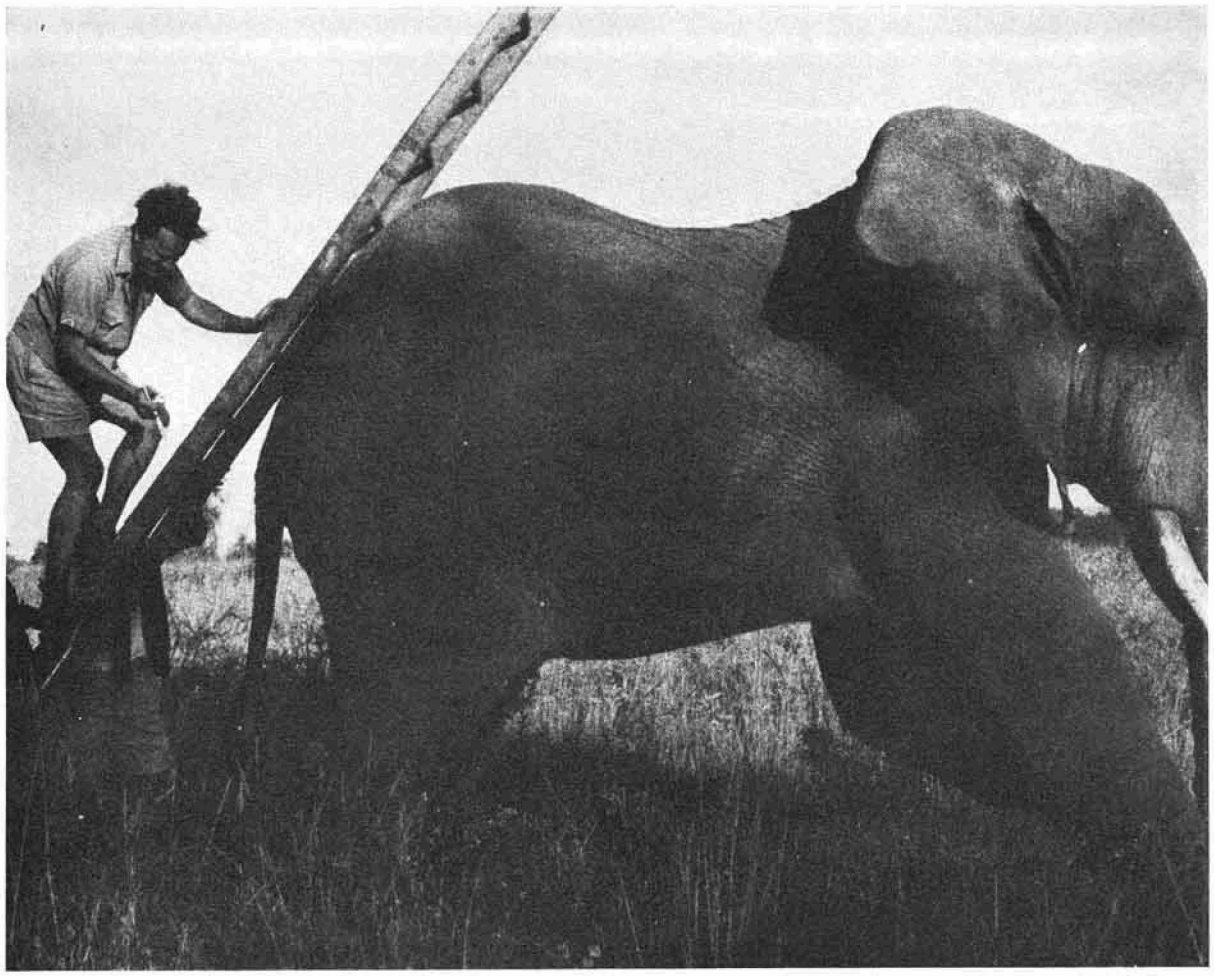
* *Diethylthiambutene*, Burroughs Wellcome and Co., London.

** *Nalorphine* (*N-allylnormorphine*), Burroughs Wellcome and Co., London.



THE REMARKABLE TRACTABILITY of normally wild and sometimes ferocious animals is demonstrated by Mr. Barrie Chappell. The object of this special manoeuvre was to reach the base of the elephant's ear for scientific measurements of blood flow and the function of the ear as a radiator for heat dissipation and thus regulation of the body temperature.

While standing immobile, they could be induced to wait an hour or so while the capture crate arrived and to walk in, once this had been placed before them.

Frequently, the animals would graze while waiting for the crate to arrive!

Judicious administration of antidote, sometimes combined with more tranquiliser, made rhinoceros sufficiently tractible to induce them to walk to a crate under their own volition and locomotory powers.

The antidote used had two advantages.

Firstly, the recuperating effect can be graduated according to the amount used.

Secondly, the antidote has negligable deleterious effects if given in amounts in excess of that required.

These qualities are in marked contrast to the antagonist to *Flaxedil*—the substance which had been used successfully (*Harthoorn and Lock*, 1959) to move black rhinoceros from the Kariba islands, but which was later found to be unsuitable for general use.

Its disadvantages were insufficiently-wide safety-margin and dangers associated with over-dosage. Small amounts of the substance were likely to cause struggling and aggression, so that control of the captured animal became difficult.

The disadvantage of the tranquiliser-Themalon-Scopolamine mixture was that it constituted large bulk—15-20 ccm. for a rhinoceros, for instance. This resulted in slow absorption.

The result was that rhinoceros took as much as half an hour to cease movement and the mixture could not be used for elephants bigger than 3,000 lbs. because the large volume "dart" became too cumbersome to project.

It was also difficult to use on hippopotamus, who were apt to get away to water during the time lapse, and unsuitable, too, for antelope as they also tended to get lost from sight. Nevertheless, for the first time we had a mixture that could be used for large animals with the reasonable certainty that no deaths would occur.

It was later used successfully by others (for instance RVC East African Expedition, 1963) and could be safely administered furthermore, by game wardens and non-specialised personnel.

A considerable percentage of non-recovery deaths had been reported on the use of all the earlier immobilising compounds, such as nicotine, succinylcholine, Flaxedil and Sernylan.

The only exceptions were in certain species such as kob (which were particularly resistant to the side effects of succinylcholine) and in cases where wardens concentrated on particular age-groups of a single species. The prime example of these latter cases was the magnificent and highly-successful work of Moore-Gilbert and Orr on wildebeest in the Ngorongoro Crater (*Orr and Moore-Gilbert*, 1964).

It may perhaps also be pertinent to mention that death from over-dosage of neuromuscular blocking agents, such as succinylcholine, is extremely unpleasant and is due ultimately to asphyxiation, because the animal can draw no air into his lungs.

When morphine-like substances are used, the animal goes into a "twilight sleep", or trance-like state, where he is largely insensitive to pain.

THE DIFFICULTY concerning large bulk associated with *Themalon* was solved with bridge-ring oripavine derivatives, or M. series compounds (*Bentley and Hardy*, 1963) and was first used for wild animal capture three years ago (*Harthoorn*, 1963).

These compounds range from 1,000 to 10,000 times the strength of morphine; using the compound M. 99*, only one three-thousandth part of the *Themalon* dose is needed for rhinoceros.

M. 99 is approximately 1,000 times as effective as morphine; but its analgesic, or pain-relieving, effect is eight thousand times as strong (*Bentley*, 1964).

With optimum doses, the recipient animal will remain standing, or walking, but will no longer respond to fear stimuli in his environment and can be approached and handled.

In many cases, wild antelope *came* to the catching vehicle, or to humans, displaying curiosity and interest, instead of fright.

The effect of M. 99 may be counteracted by *nalorphine*, or others of the M. series, such as M. 285**. Animals recover in 30 to 60 seconds after the intravenous injection of the antagonising compound.

A number of animals—approaching 300, of 17 different species—have now been captured with M. 99. Routine mortality—usually associated with misadventure—was about one in 100 captures, a figure that compares favourably with large-animal field anaesthesia in veterinary practice.

Initial difficulties were experienced with elephant and some of the more nervous type of antelope, such as nyala; but these have been resolved and the capture of elephant, in particular, can now be regarded routine procedure. In 1964, considerable number of dosages for Kenya conditions were compiled by Mr. Barrie Chappell who met a tragic death in 1965.

His was the first thorough groundwork in Kenya on a wide range of species and the chemical capture included antelope, zebra, and elephant.

It is hoped that others will continue the work and build on the foundations he has laid.

BIBLIOGRAPHY

Bentley, K. W. (1964)
The relief of pain: The search for the ideal Endeavour **83***; (No.* **89) 97-101.**

Bentley, K. W. and Hardy D. G. (1963)
New Potent Analgesics in the morphine series; Jour. Chem. Soc., July, page **220.**

Bentley, K. W., Boura, A. L. A., Lister, R. E., Fitzgerald, A.E., Hardy D. G., McCoubrey A., and Aikman M. L.
Compounds containing Morphine-antagonizing or Powerful Analgesic Properties Nature **206***:* **102-103**

Buechner, H. K., Harthoorn, A. M. and Lock, J. A. (1960)
The Immobilising of Uganda Kob with Succinylcholine Chloride Canad. Jour. Comp. Med. **24***:* **371-324**

Harthoorn, A. M. (1963)
The value of Neuroleptic Narcosis in restraint, compared to that of anaesthesia, sedation or paralysis. Proc. Symp. on African Mammals, Zool. Soc. S.A., Sept.

Harthoorn, A. M. and Lock, J. A. (1960)
The Rescue of Rhinoceros at Kariba Dam Jour. Fauna. Press. Soc. (Oryx) V(6) **352-355**

Members of the Royal Veterinary College East Africa Expedition (1963)
The use of a thiambutene/Phencyclidine/hyoscine mixture for the immobilisation of the TOPI (DAMALISCUS KORRIGUM) and the Hippopotamus (HIPPOPOTAMUS AMPHIBIUS). VET. REC. **75***:* **630-633.**

Orr, S. M. and Moore-Gilbert, D. J. C. (1964)
Field immobilisation of Young Wildebeest with succinylcholine chloride. E.A. Wildlife Jour. **11***:* **60-66.**

* M.99 (Reckitt) is 6, 14-*endoetheno*-7*a* (2-*hydroxy*-2 *pentyl*)—*tetrahydro-oripavine hydrochloride.*

** M.285 is *N-cyclopropylmethyl*-6: 4-*endoetheno*-7-(2-*hydroxy*-2-*propyl*)-*tetrahydro-nor*oripavine *hydrochloride.* Currently, small quantities of these substances are available, for biological research and investigational purposes only, on request from Reckitt & Sons Ltd.; but—as with M.99—a commercial preparation is likely to be marketed in the near future.