LABORATORY PRIMATE NEWSLETTER

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POLICY STATEMENT

The purpose of the *Laboratory Primate Newsletter* is (1) to provide information on care, breeding, and procurement of nonhuman primates for laboratory research, (2) to disseminate general information about the world of primate research (such as announcements of meetings, research projects, nomenclature changes), (3) to help meet the special research needs of individual investigators by publishing requests for research material or for information related to specific research problems, and (4) to serve the cause of conservation of nonhuman primates by publishing information on that topic. As a rule, the only research articles or summaries that will be accepted for the *Newsletter* are those that have some practical implications or that provide general information likely to be of interest to investigators in a variety of areas of primate research. However, special consideration will be given to articles containing data on primates not conveniently publishable elsewhere. General descriptions of current research projects on primates will also be welcome.

The *Newsletter* appears quarterly and is intended primarily for persons doing research with nonhuman primates. Back issues may be purchased for $1.00 each. (Please make checks payable to Brown University.)

The publication lag is typically no longer than the 3 months between issues and can be as short as a few weeks. The deadline for inclusion of a note or article in any given issue of the *Newsletter* has in practice been somewhat flexible, but is technically the fifteenth of December, March, June, or September, depending on which issue is scheduled to appear next. Reprints will not be supplied under any circumstances.

PREPARATION OF ARTICLES FOR THE *NEWSLETTER*.--Articles and notes should be submitted in duplicate and all copy should be double spaced. Articles in the References section should be referred to in the text by author(s) and date of publications, as for example: Smith (1960) or (Smith & Jones, 1962). Names of journals should be spelled out completely in the References section. Technical names of monkeys should be indicated at least once in each note and article. In general, to avoid inconsistencies within the *Newsletter* (see Editor's Notes, July, 1966 issue) the scientific names used will be those of Napier and Napier [*A Handbook of Living Primates*. New York: Academic Press, 1967].

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ACKNOWLEDGMENT

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Managing Editor: Kathryn M. Huntington

CONTENTS

MODIFICATION OF THE COUCH METHOD FOR CHRONIC RESTRAINT OF LARGE NONHUMAN PRIMATES[1]

Elizabeth M. Cuthbertson and Rutherford S. Gilfillan

Children's Hospital of San Francisco

Experiments using chronically implanted sensing devices in the unanesthetized monkey require measures for protection of these devices, often including prolonged restraint (Cuthbertson & Gilfillan, 1971). Prevention of ulceration over bony prominences during chronic restraint requires changes in position of the animal, minimizing of pressure over vulnerable points and maintenance of smooth surfaces for the animal to rest on. These requirements have been achieved by modifying the methods of Rahlmann *et al.* (1964). In this method, a monkey wore a short-sleeved nylon mesh suit which was tied in the back. A large apron of material extending from the sides and front of the suit was used to tie the animal into a molded fiberglass couch which was contoured to fit the form of the animal in a recumbent position with the thighs moderately flexed. The couch was then housed in a standard 55 gallon metal drum. A food container was fastened to the inside of the drum and a device holding a standard water bottle was fastened across the drum in front of the monkey. This device had to be removed in order to remove the animal.

The major modifications are: (1) The entire restraining unit has been mechanized to provide programmed changes in its position; (2) the seats of these units have been padded with silicone rubber; (3) the restraining suits have been redesigned so that there are no seams, ties, grommets or other irregularities in the back to provide pressure points; (4) a slot has been cut in the back of the fiberglass couch so that the animal does not rest on its vertebral spinous processes; (5) the inside of the lower end of the couch has been padded with Skinguard[2]; (6) feeding and watering equipment have been improved (Figures 1 and 2).

Two types of suits are used, one when the animal is caged and another when it is restrained in the couch. These are made of a heavy nylon mesh cloth (see Appendix). The cage suit (pattern shown in Figure 3) is made with a separable heavy duty jacket zipper in the back, closing toward the top. In making the suits all seams are sewn

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[1]Supported by USPHS Grant No. HE09615, from the National Heart Institute.

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This laboratory is fully approved by the American Association for Accreditation of Laboratory Animal Care.

[2]Materials used are described with sources and additional information in the Appendix.

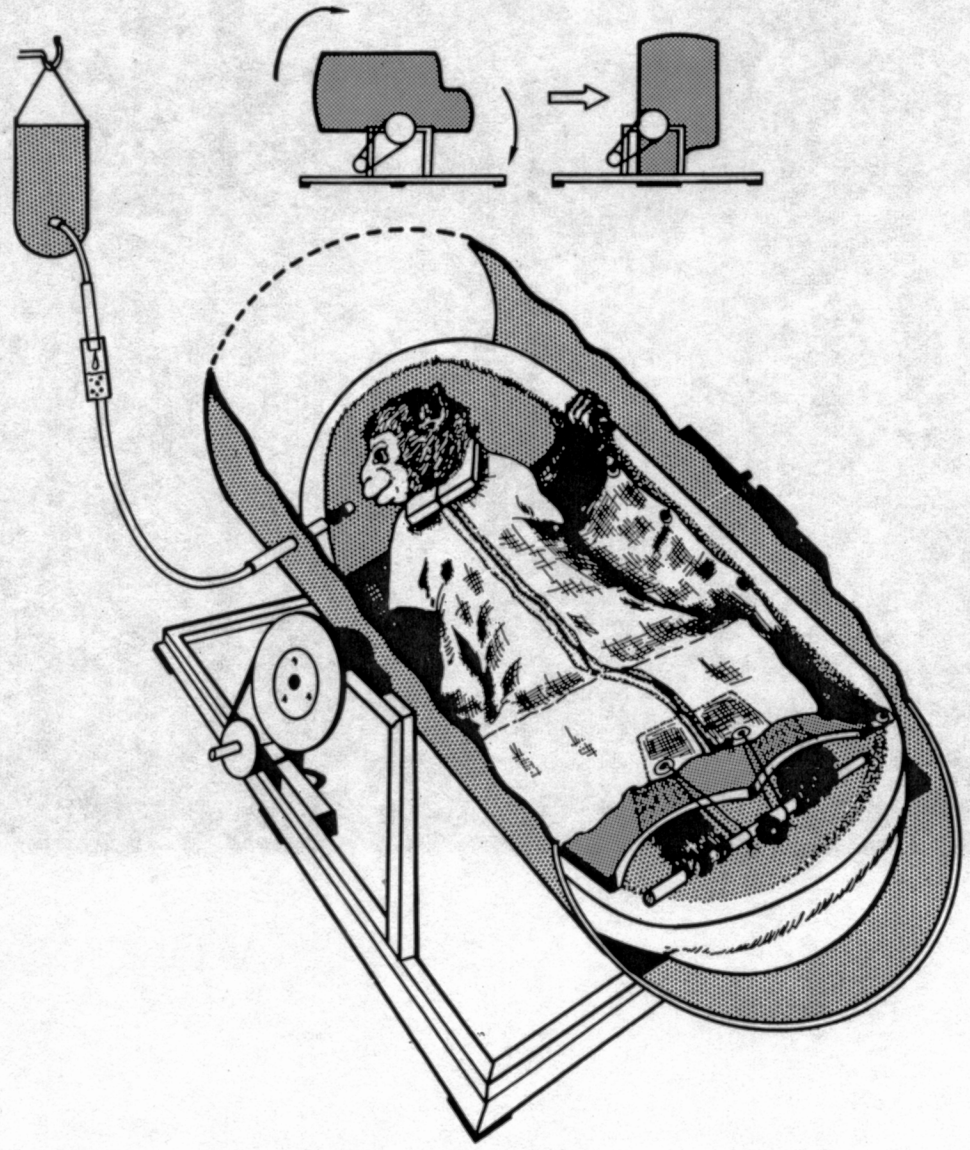


Figure 1. Diagram of monkey and couch in drum of tilting unit.

Figure 2. Rhesus monkey restrained in couch with watering device, shelf and protective wire guard in place.

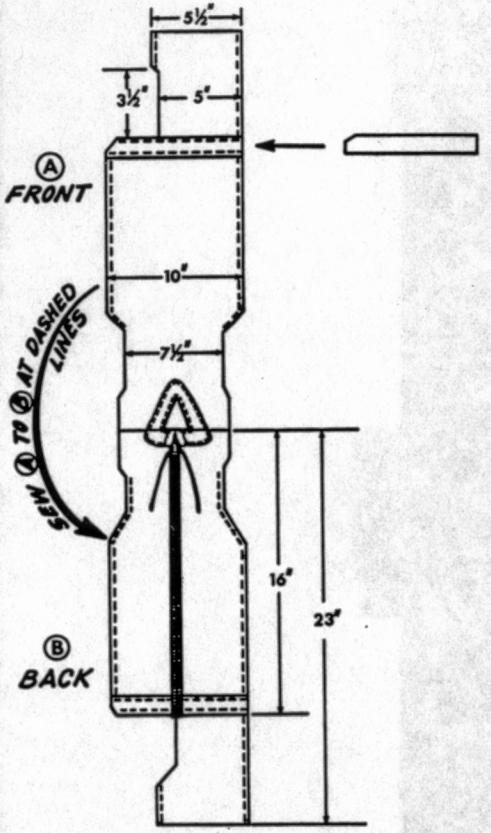


Figure 3. Pattern for cage suit for 18 to 20 pound rhesus monkey. See text for details.

two or three times (or with a zigzag stitch) and the ends are oversewn so that they are secure. The suit is not turned after being sewn so that it is worn inside-out, leaving smooth surfaces in contact with the monkey. This minimizes chafing and binding. After the suit is put on, the tab of the zipper slide is sewn to the cloth with heavy thread (or an extra tab of cloth is attached to the suit for this purpose). The neck is secured by a drawstring tightly knotted. There is an additional drawstring at the bottom of the suit, secured by several layers of adhesive tape applied over the bottom of the suit and the animal's abdomen. Considerable discretion is required to tie the drawstrings securely but so as not to bind the animal. The fit here and at the axillae and leg must be checked periodically, especially if the animal gains weight. If necessary, openings may be enlarged by cutting either the stitching or the cloth. When suits are comfortable, the animals rarely bother them. If a monkey fingers an area and licks his fingers, this is presumptive evidence of tissue breakdown as is staining of the suit or chewing of it. The cables and catheters which lead out of the animal are packaged in small leather coin or key purses and are slipped into lined pockets on the inside of the back of the suit. The pocket is closed with tape or by sewing. No animals have removed equipment from these pockets.

The restraining or couch suits (Figure 4) have a long extra heavy duty jacket zipper, with crown teeth, in the front, installed with the slide at the bottom when it is closed, so that the monkey cannot reach it. This suit is made of one piece of material except where it needs reinforcement; there are no seams in the back. There is a drawstring at the neck. The animal in his suit is placed in the contoured fiberglass couch (Figures 1, 2, and 5, Part No. 1). Seats (Figure 5, Part No. 14) padded with silicone rubber are attached by screws to a slotted metal bar (Part No. 15) installed across the seat hole, which allows some adjustment of their position. After application of compound tincture of benzoin to the couch, Skinguard is glued to the inside of the lower one-half of the couch covering 2 to 3 inches on each side of the back slot. The edges of the Skinguard are secured with adhesive tape.

The edges of the suit are stretched and held flat against the couch by tieing the grommets with wire to holes drilled as needed in the couch. Care must be taken not to pull the edges upward in such a way that the monkey is suspended by his axillae when he is upright. The apron of the suit is stretched over the plastic leg shield (Part No. 3) which has been fixed in place by bolting it to the couch. The pieces of light-weight canvas sewn to the sides of the suit are tied to each other over the top of the zipper (Figure 4 C and D). The canvas should also be sewn or tied to the suit at the zipper. Before this measure was adopted, a few monkeys pulled apart the zippers.

A wooden shelf (Part No. 8) on angle iron (Part No. 10) is bolted to the front of the couch so that the monkey can lean on it; it also keeps his hands away from everything below it. A wide-mouth mason jar top (Part No. 7) is fastened to the bottom of the shelf and a hole is

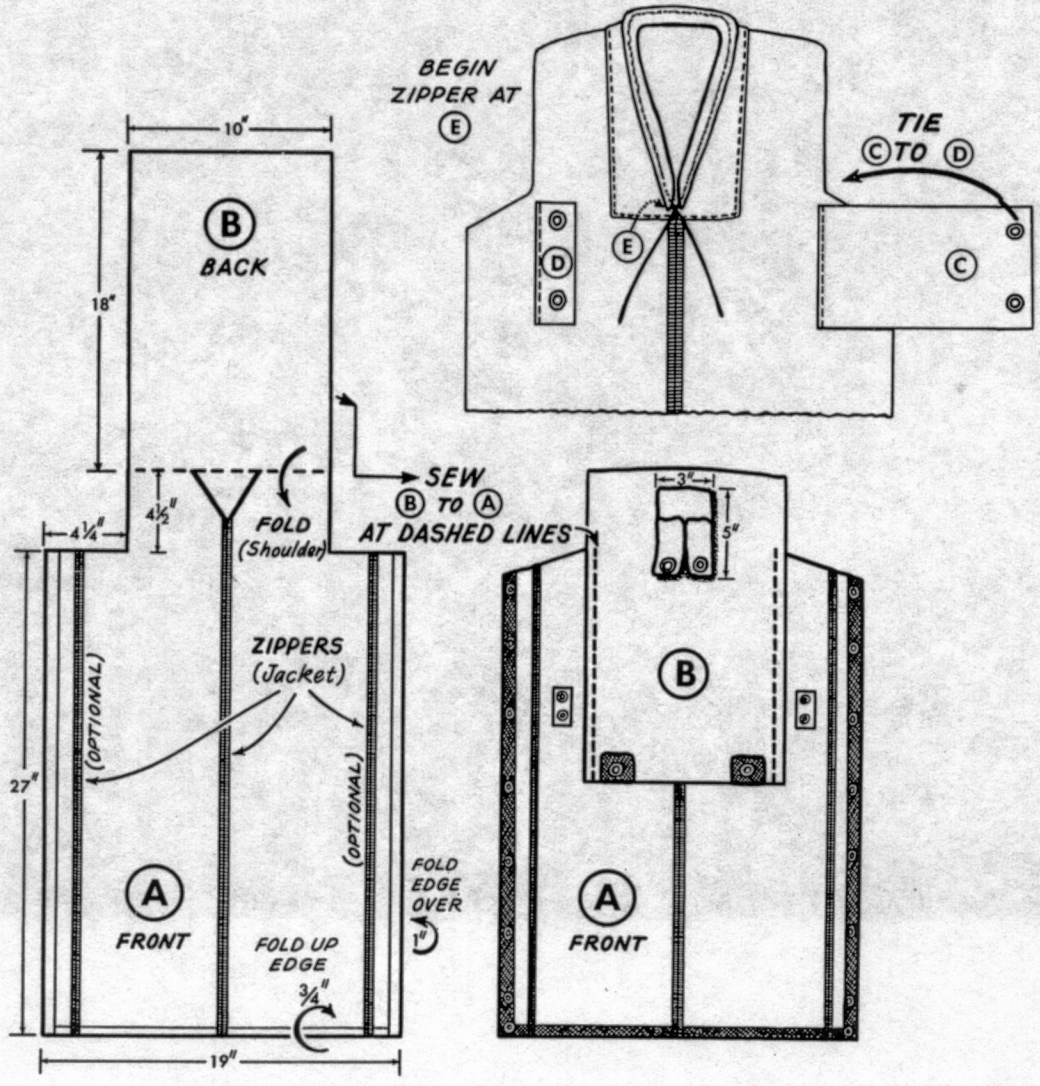
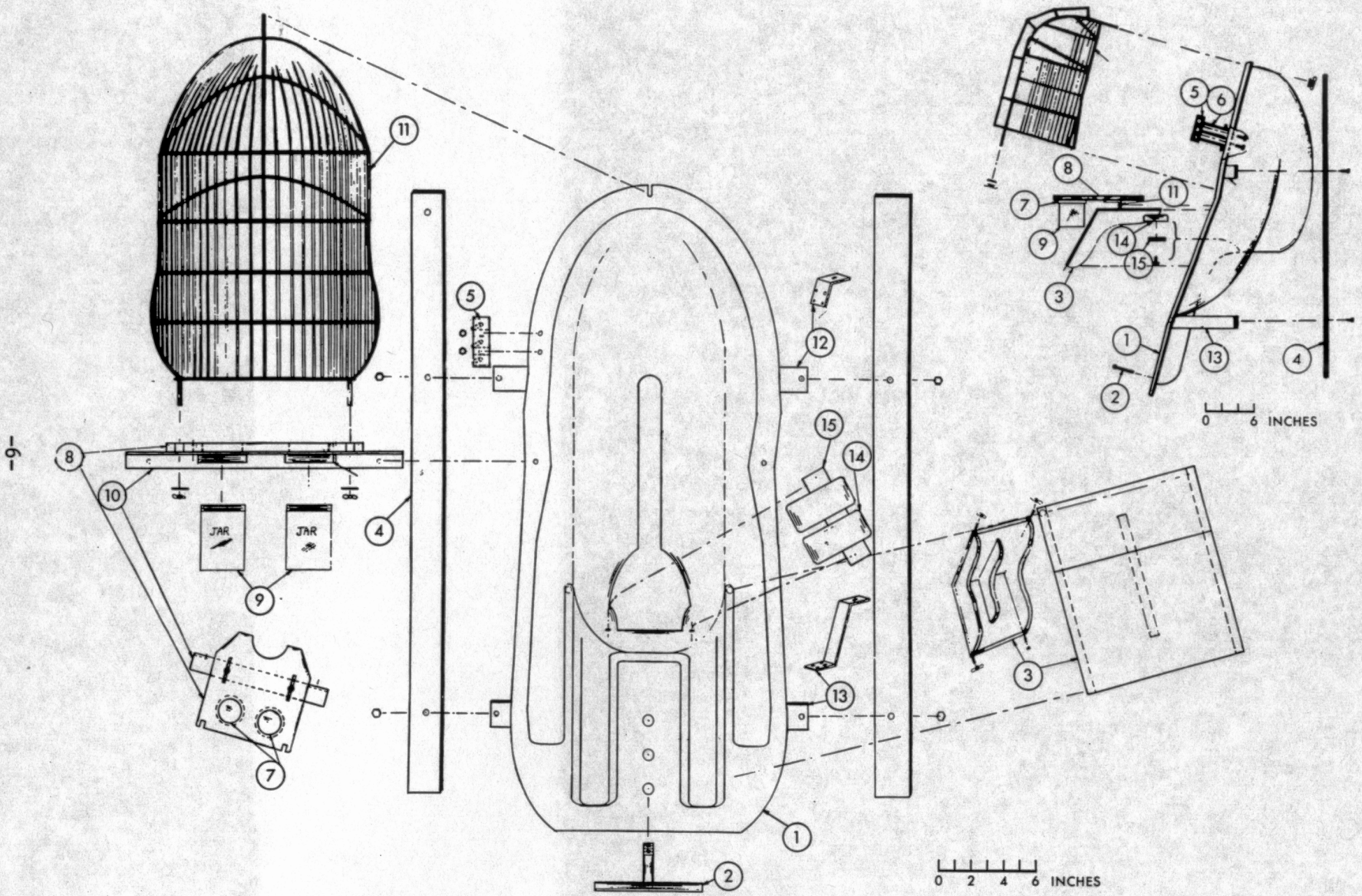


Figure 4. Pattern for restraining suit for 18 to 20 pound rhesus monkey. The optional side zippers should usually be omitted. Note the detail of the neck with drawstring and canvas flaps to be tied over the top of the zipper. See text for details.

cut in the shelf, so that, when a jar (Part No. 9) of food pellets is screwed to the top, the monkey can reach them.

The grommeted tabs at the back of the neck of the suit are brought out through two large holes at the back of the couch and a sturdy snap fastener put through the grommets. When the monkey is known to be especially aggressive, a plastic collar (Rahlmann *et al.*, 1964) and chain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may also be used. With this securely fastened to the back of the couch, the monkey will be held even if he escapes from his suit. Long cords are used to tie the two grommets at the bottom of the back of the suit to the metal supports of the couch to keep the back of the suit stretched flat, but they must be loose enough to allow movement of the monkey. Folds in the back of the suit may cause tissue breakdown.

The couch unit containing the monkey is slipped into the 55 gallon barrel of an automatic tilting unit which changes position on a schedule determined by a timer. Monkeys usually tolerate 1 to 2 hours in a horizontal position and 2 to 3 hours in a vertical. A watering valve which is connected to a gravity water supply is attached to the side of the couch within reach of the monkey's mouth. The watering valve is one which is activated by the monkey's tongue or mouth pushing a small central pin. Since this must be detached when the couch is removed from the barrel, the valve is held in a hole in a metal block (Part No. 5) by means of a long set screw (Part No. 6) which can be reached though the back of the barrel so that the experimenter's hands are never within reach of the monkey. The block has three holes so that the position of the valve in relation to the monkey's mouth is adjustable or so that several liquids can be offered to the monkey simultaneously. Apple juice is often given to encourage fluid intake. Hard boiled eggs, served at room temperature, make an excellent and accepted protein supplement.

Animals are examined frequently for skin ulceration. The areas to be inspected are the neck, axillae, back and ischial callosities. Staining of the suit may be noticed or fingering of the area by the monkey. A later indication is the smell of infected tissue. Increased aggressiveness or restlessness may indicate breakdown in areas which are not easily seen.

We have had monkeys in chronic restraint for periods up to five months and since the institution of all the measures described have had no serious ulcerations except in animals with illnesses (myocardial infarction, myocarditis, pneumonia). Weight loss has been minimized.

When the couch is to be removed from the barrel without tranquil-

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Figure 5. Scale drawing of restraining couch and attachments--front view, with side view in right upper corner. 1. Fiberglass couch. 2. Rod for footrest. 3. Plastic shield over legs. 4. Aluminum struts which support couch in barrel. 5. Metal block which holds watering valves. 6. Long set screws to fasten watering valves. 7. Mason jar lid fastened to bottom of shelf. 8. Wooden shelf. 9. Mason jars for food. 10. Angle iron support for shelf; bolts to front of couch, just below elbow level. 11. Wire guard to protect personnel when handling unmedicated monkey. Bolts to shelf and top of couch. 12. Pair of metal feet to be set in fiberglass when it is molded (see Appendix). 13. Lower pair of metal feet. 14. Silicone rubber padded seats. 15. Slotted metal bar for seats.

ization of the animal, a wire mesh guard (Part No. 11) is slipped over the upper half of the monkey and bolted to notches in the couch and shelf.

Another problem with restrained nonhuman primates is boredom or restlessness. We had an especially serious problem with one rhesus monkey (*Macaca mulatta*) who spent his time picking and licking at his hands and arms until he had multiple small chronic ulcers. After reading of the use of television at the Yerkes Regional Primate Research Center (Anon., 1970) to amuse chimpanzees, we provided this animal with daytime television; his ulcers rapidly healed and no more developed.

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Anonymous Apes join rest of us out there in TV-land. *Yerkes Newsletter*, 1970, *7*, 15.

Cuthbertson, E. M., & Gilfillan, R. S. Direct measurement of external iliac artery blood flow in the awake unmedicated primate (rhesus monkey): effect of sympathectomy. *Journal of Surgical Research*, 1971, *11*, 18-22.

Rahlmann, D. F., Hansen, J. J., Pace, N., Barnstein, N. J., & Cannon, M. D. Handling procedures and equipment for physiological studies on the pig-tailed monkey (*Macaca nemestrina*). *Laboratory Animal Care*, 1964, *14*, 125-130.

APPENDIX

Nylon cloth: Pattern #23044, Native Laces and Textiles Co., 261 5th Avenue, New York, New York 10016.

U.C. Fiberglass couch: Slakey Industries, 1137 57th Avenue, Oakland, California 94621. This comes in two sizes--standard and extra-long (for tall monkeys--rhesus of 20 pounds or more; *M. nemestrina* monkeys are shorter for the same weight and fit the standard couch more often). The four metal feet (Figure 5) for incorporation into the fiberglass must be supplied to the vendor with purchase order.[3]

Silicone rubber for seat padding: Dow Corning Silastic RTV 588

Formula for 1 pad:	RTV 588	2 tablespoons
	RTV 588 Thinner	1-1/2 teaspoons
	RTV 588 Catalyst	1/4 teaspoon

This is spooned into a form; the seat is suspended in it, and the material is allowed to set 12-24 hours. Roughening and slotting of the seat prior

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[3]The authors have several excess standard size couches (without accessories) available at the original purchase price.

to forming the padding improves the fixation of the rubber to it.

Watering valve: Tilt Valve #TV-100, Systems Engineering, Napa, California. The non-adjustable valve is more satisfactory than the adjustable model (TV-300) which requires repeated re-adjusting. In areas where the tap water contains particulate matter, filtered or distilled water should be used.

Skinguard: Distributed by Stryker Corp., Kalamazoo, Michigan. (Developed by Spenco Corp., Salt Lake City, Utah.) The adhesive on the back of this product is not adequate to adhere to the couch. The couch is therefore first painted with compound tincture of benzoin.

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MEETING ANNOUNCEMENTS: AALAS SYMPOSIUM ON LABORATORY ANIMAL CONSIDERATIONS IN TOXICOLOGY AND RELATED DISCIPLINES

The Delaware Valley and Metropolitan New York Branches of the American Association for Laboratory Animal Science are sponsoring a symposium to be held on June 1 and 2, 1972, at the Ramada Inn, East Brunswick, New Jersey, just off Exit 9 on the New Jersey Turnpike. The topic of this symposium will be Laboratory Animal Considerations in Toxicology and Related Disciplines. For further information, contact Mr. W. H. Mitchell, P. O. Box No. 130, New Britain, Pennsylvania 18901.

* * *

NEW PRODUCTS AND SERVICES

(All information in this section has been abstracted from material supplied by the vendor)

CAROLINA BIOLOGICAL SUPPLY COMPANY [Burlington, North Carolina 27215 and Gladstone, Oregon 97027] is offering a new set of primate tissue slides for histology. The tissues are stained with hematoxylin and eosin. The range of thickness is from 5 to 10 microns for light microscopy. The slides are $1.00 each.

* * *

REQUEST FOR PRIMATE MATERIAL: LOWER LIMBS

We need lower limbs of New and Old World monkeys and apes for locomotor studies.--Contact: Dr. Michael I. Seigel, Department of Anthropology, University of Pittsburgh, Pittsburgh, Pa. 15213.

PROBLEMS OF NEW WORLD PRIMATE SUPPLY[1]

C. C. Middleton[2]

Bowman Gray School of Medicine

A. F. Moreland

College of Medicine, University of Florida

R. W. Cooper[3]

Institute of Comparative Biology, Zoological Society of San Diego

Sources of New World primates from Brazil (through Colombia) and Peru are presented. Capture methods vary with the species and housing varies from very bad to good. Bananas are the primary diet from capture to shipment. Regulations governing exportation and importation and certain potential disease hazards are described.

Until recently New World primates have not received a great deal of emphasis as research subjects. Old World species, perhaps because of larger size, adaptability for certain experiments, and greater availability of normative data, have been more widely used. Recent emphasis on the search for inexpensive, easily housed and cared for small primates for use in behavioral, cancer, atherosclerosis and other biomedical research areas has greatly increased the utilization of New World primate species. It, therefore, becomes increasingly important to the scientific community to better understand problems of New World primate supply and importation.

A book co-edited by one of the authors (Rosenblum & Cooper, 1968) reviews some of the problems of New World primate supply and number of primates imported; therefore that data is not presented.

The material presented was gathered by the authors while conducting field research (C.C.M.) and while studying primate supply problems (A.F.M. and R.W.C.) in 1964 and 1965 in Colombia, Peru, and Brazil.

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[1]Supported in part by N.I.H. Grant FR00180 and the United Health Foundation. Studies of R. W. Cooper were aided by Contract PH-43-63-56 within the Special Virus Leukemia Program of the National Cancer Institute, N.I.H., P.H.S.

[2]Present address: Sinclair Comparative Medicine Research Farm, University of Missouri, Route 3, Columbia, Missouri 65201.

[3]Currently in Peace Corps in South America.

Areas of Primate Export Commerce

Most New World primate species imported by the United States are collected from the areas around 3 cities: Barranquilla in North Coastal Colombia, Leticia, Colombia on the Amazon River, and Iquitos in the upper Amazon basin of Peru (Figure 1). Very few primates are exported from

Figure 1. Map of South America showing sites of primate commerce.

Brazil because of governmental protective regulations, hunting fees, and taxes. However, limited numbers are shipped from Manaus, Belem, Recife, Rio de Janeiro and Sao Pãulo principally to Europe. Monkeys of Brazilian origin also are traded across both state and national boundaries and some make their way to Leticia, Colombia, and are exported to the United States under the more liberal Colombian export regulations.

The volume and growth of traffic in New World primate exportation

are discussed by Cooper (1968) and will not be reviewed here.

Methods of Acquisition of Primates at Point of Origin

In the areas of primary primate commerce (Leticia, Barranquilla, Iquitos) animal dealers usually purchase monkeys, marmosets and other animals from natives. It is the custom in these areas for residents to trade daily in bazaar or open-air-market fashion. Natives from the surrounding area bring their agricultural products, fish, animal skins, crafts and live animals by river to the market place for barter or sale. Established animal dealers usually build up a "clientele" of natives who bring their animals especially to them for sale. Even so, competition is keen, and the laws of supply and demand usually regulate the market. In order to maintain sources for future supply, and at times to fill pressing orders, dealers frequently purchase unthrifty or ill animals along with better specimens. Dealer losses, therefore, are often larger than if only the healthiest specimens were selected for purchase.

Arrival at the market and subsequent purchase by the animal dealer culminates a series of events for the animals that began several days to weeks earlier. Natives utilize a variety of methods to capture primates and other animals. Some of the primate trapping methods related by natives and dealers, are quite interesting.

In trapping *Cebuella pygmaea* (pygmy marmosets), acacia-like gum is said to be spread thickly on certain trees; and when these tiny primates walk into this gummy mass, they are unable to extricate themselves. They are then collected as the native collector makes daily rounds of his traps; the gum is usually removed from their coats with a solvent.

Box and drop traps are reportedly used for *Saimiri* (squirrel monkeys), *Cebus* (capuchin monkeys), *Saguinus* (tamarin marmosets), and other species of intermediate size. Such traps are baited with bananas or other fruit and usually utilize a spring treadle but may have a treadle actuated by a string which is held by a native hidden in jungle foliage some distance from the trap.

One dealer reported that *Cebus* travel in groups and usually sleep in a single large tree. He described a method of capture in which natives would follow the monkey troop until nightfall and observe the nesting tree. Later in the night, surrounding trees would be felled to form a clearing. At daylight one native would climb the tree thus forcing the monkeys to abandon their perch by jumping to the ground below where they would be caught by natives on the ground. A variation of this technique was said to be used with other species in the "overfloated" area of the Amazon River basin during high water. Natives used canoes, and when the animals jumped from the nest tree into the water, they were easily captured.

Larger species such as *Lagothrix* (wooly monkeys), *Alouatta* (howler monkeys), *Ateles* (spider monkeys), and *Cacajao* (uacaris), usually serve as food for the natives. Adult animals are shot down for this purpose and thus rarely appear on the market. Their babies are ordinarily retrieved and retained for sale to animal dealers; dependent infants are often carried by native children until they are old enough for sale.

Natives sometimes live a great distance from the towns where animal dealers operate. One dealer in Iquitos, Peru, claimed that he dealt with natives who live as much as 150 miles upriver. In the Amazon Basin there are few roads and people of necessity travel by canoe or boat to market. If a trapper lives at some distance from town such trips may be infrequent and in the interim between capture and eventual sale his animals are crudely caged and generally fed "fruits of the area." Such a diet begins a sequence of events which may lead to severe protein depletion.

Animal Dealer Facilities

South American animal dealers (exporters) vary widely in the conduct of their businesses. Some dealers work at this activity as a sideline to more lucrative commercial endeavors, whereas others make it their primary source of income. Their compounds frequently reflect the particular emphasis placed upon the animal business. Some facilities were well designed and very functional, such as the compound of Jaime Vidal in Iquitos and the Tarpon Zoo's compounds in Leticia and Barranquilla. Those compounds were screened, had concrete floors bedded with woodshavings, had an adequate roof, were well ventilated and permitted the good husbandry practices which were generally observed. Other compounds varied from the above quality to much less satisfactory designs; however, crowding of monkeys and inadequate waste removal seemed to be a greater cause of health problems than inadequate cage design *per se*.

Generally, after purchase, primates are held in compounds such as those described above and provided a diet usually consisting again of "fruits of the area" (mainly bananas or plantain) until shipment can be arranged. This diet further contributes to the protein depletion begun earlier in the facilities of the animal trappers. As the cost of adding protein to the diet of primates awaiting exportation is usually prohibitive, dealers attempt to limit protein depletion by exporting their animals soon after purchase.

Most dealers constructed their own shipping crates; and, in general, these were adequate because of requirements of the airlines and regulations of the U.S. Public Health Service and U.S. Customs. Most crates were double screened, had provision for watering animals during shipment, and contained absorbent material or litter trays to prevent soiling of transport quarters and leakage.

Primary U. S. Markets

The U.S. import markets for South American primates are of three major types: (1) pet shop trade, (2) research animal trade or (3) mixed (research and pet) trade. At the time of our investigations (1964-65) the highly competitive pet shop trade accounted for the majority of the market. Most U.S. import dealers, therefore, conducted their businesses in a manner intended to minimize overhead expenses and death losses while primates were in their possession. Shipments were generally scheduled from the South American dealers to correspond with the seasonal variation in demand experienced in the exotic pet industry. After importation into the U.S., primates were sometimes even shipped to pet shops or research laboratories within several hours to several days after receipt by U.S. dealers. Such primates arrived at their destination in an unacclimatized state and often suffering from severe protein depletion.

Dealers should be encouraged to condition imported primates, especially those destined for research use. A program of sound nutrition, deworming and general acclimatization to conditions of captivity are desirable. Obviously, animals handled in such manner are superior research specimens and losses during quarantine periods at research institutions are drastically reduced. It would, however, be incumbent upon the scientific community to realize the increased value of such animals and to bear a fair expense for the improved service.

Export and Import Regulations

Colombian and Peruvian export and U.S. import regulations are shown in Table 1. The mode of transportation from South America is by plane. The time required from Leticia to the United States is about 13 hours, and from Barranquilla about 6 hours. In addition to those listed, a South American regulation also exists which provides that a veterinarian must sign a form certifying that the animals are in a good state of health and suitable for export. As far as could be determined, this latter regulation was poorly adhered to in South America; indeed, it appeared the dealers themselves frequently signed the form.

Regarding U.S. yellow fever regulations, the nine-day quarantine (behind double insect-proof screens) of primates, applied to all South American countries in which shipments of monkeys originate. The adherence to this regulation by South American dealers is in doubt and was not observed in any compounds visited. The regulation which applies to insect-proof shipping crates is adhered to because of U.S. Public Health Service enforcement at the port of entry. The other regulations are controlled by the U.S. agencies and appeared to be enforced, although the effectiveness of the required post-mortem examination of animals found dead on arrival is questionable. This work was done by local veterinary practitioners chosen by the consignee (importer) some of whom related that they were not knowledgeable regarding diseases of primates and would not likely recognize yellow fever if they saw it. It seemed likely that very per-

Table 1

Export-Import Regulations for Primates from Colombia and Peru to the United States

I. Colombia and Peru Regulations: An export license is required.

United States Regulations:

A. A nine-day quarantine of primates in Colombia and Peru, in double-screen wire cages.
B. Primates must be shipped in crates free from cracks and also with double-screen wire.
C. Primates must enter the country accompanied with a screening and health certificate from a licensed veterinarian.

II. Regulations in United States if the shipment fails to comply with the above:
Compulsory Federal Government quarantine of the shipment for nine days.

III. Regulations in the United States if the requirements are met at the port of entry:
The shipment is off-loaded and inspected by four government officials.

A. Customs inspector: Inspects entire cargo of the plane.
B. Customs appraiser: Counts every animal in the shipment for duty purposes.
C. U.S. Public Health: Inspects for proper packing, screening, and dead animals.
D. Plant Board: Inspects for proper packing material, proper feed, and external parasites.

IV. Regulations concerning shipment if any primates arrive dead on arrival: Autopsy is required before shipment is released.

V. Packing of Food: Primates are permitted to be packed with wood shavings for entry into the United States, and only bananas are permitted to be packed for food.

functory necropsy examinations were usually performed.

The time required to clear customs is 2 to 4 hours for shipments consisting of 100 to 200 crates. Following clearance from customs, the animals are free to go to the dealers for distribution.

Discussion

New World primates have a wide geographic range which extends throughout most of the tropical areas of Central and South America. A few species, however, such as *Callithrix jacchus* and *C. pencillata*, the most common fringe-eared marmosets, are found only in eastern Brazil in the states of Bahia, Pernambuco, and Piaui. *Leontideus rosalia* (lion marmoset) is found only in a very small area in the Brazilian state of Rio de Janeiro (and, incidentally, is in grave danger of extinction and should not be considered as an experimental animal). As stated earlier, Brazilian governmental regulations severely restrict export of Brazilian animal species; and studies which require their continued use should be carefully considered prior to initiation. Other species such as *Saimiri*, *Cebus*, *Saguinus*, *Ateles*, and *Lagothrix* exist in substantial numbers in other South and Central American countries. It would, therefore, appear that supplies of these species could be effectively sustained except for adult animals of the larger species which, in addition to being popular native food items, are difficult to handle and export successfully.

The problem of primate death losses along the chain of supply and in those animals going to the pet market, although not known in exact figures, is significantly large to be of great concern. The scientific community should exert every effort to better define and assist in the reduction of this loss. One way this may be affected is by careful evaluation of animal suppliers and purchase of conditioned or acclimatized specimens. Unfortunately, major losses occur among pet primates and control of the number of animals going to the pet market would be most difficult.

Export and import regulations should be more carefully observed. A potentially severe hazard exists in failure to comply. Many New World primates originate from areas in which yellow fever is endemic, and transportation to the United States may involve only a matter of hours. Coupled with the fact that the major port of importation (Miami, Florida) is subtropical and *Aedes aegyptii*, a yellow fever mosquito vector, is endemic in many areas of Florida, a hazardous situation may exist. *Trypanasoma cruzi* has been reported in New World primates and also may present a potential hazard, since vectors of this parasite (reduvid bugs) are present in the United States.

The authors present this paper with the hope that the information contained herein will stimulate other investigators to seek out more precise information about the New World primates which they use and the companies which supply them. Hopefully, they will then demand the best quality of experimental subject which is potentially available.

The information presented here is based upon personal observations of the authors in 1964-65. Some things may have changed since that time but no information is available to indicate what changes, if any, have occurred, particularly in South America.

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TISSUE BANK AT ST. LOUIS ZOOLOGICAL PARK

In 1966, The St. Louis Zoological Park received support for the establishment of a Tissue Bank to make available to bio-medical researchers and educators tissues from exotic fauna that have died in the collection at the St. Louis Zoo. It is felt that the Tissue Bank is a valuable contribution to the scientific community as well as a service to the conservation of wildlife. It enables researchers to obtain tissues from exotic fauna that otherwise would not have been available to them. It conserves the rare and endangered wildlife that would have been sacrificed had these tissues not been provided.

The Tissue Bank has been reorganized during the past year and we now have over 1,500 specimens representing almost every order of mammals, birds, reptiles, and amphibians. We are making these tissues available at a nominal cost on a weight basis with a graduated scale to cover the cost of handling, catalogs, reagents, etc.

We have recently completed a 52-page catalog listing available tissues. For copies of the catalog or any other information please contact Dr. William J. Boever, Tissue Bank, St. Louis Zoological Park, St. Louis, Missouri 63110. (Telephone: 314-781-0900, Extension 77)

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FIELD NOTES: *INDRI INDRI* RESPONDS TO OWN RECORDED CALLS

While camped in the eastern rain forest of Madagascar on an expedition to study chameleons, I recorded the call of a solitary *Indri indri* who was in a large *Eucalyptus* (introduced) nearby. Upon replaying the call, the *Indri* repeated the call. During two hours, the animal gave the call six times, each time directly following the playing of the recording. If the recording was played during a period of about five minutes after a call, no new call would ensue. At the end of the sixth call the *Indri* was "answered" by another call which at the time I estimated to be one-half to one kilometer away. Though about fifty meters from the animal and in clear view, I was not able to determine the sex.--Stephen R. Parcher, School of Hygiene & Public Health, The Johns Hopkins University (Present address: 1603 Stockton Avenue, Bakersfield, California 93308).

INITIAL EXPERIENCES WITH KETAMINE ANESTHESIA IN NONHUMAN PRIMATES[1]

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Ketamine was evaluated as a general anesthetic and immobilizing agent in three species of macaques. It was found valuable for (1) non-painful diagnostic or experimental procedures, (2) minor surgery, (3) induction of general anesthesia prior to maintenance with a barbiturate, and (4) extension of barbiturate anesthesia. No fatalities or significant complications were experienced and no long-term effects have been noted. It appeared to be less useful as the sole agent in major or long surgical interventions.

Manual or mechanical restraint is inadequate for many procedures with most commonly used laboratory primates, and on such occasions some form of pharmacological restraint must be employed. If it were possible to "design" an agent expressly for this purpose we would specify the following characteristics:

1. Reliable and rapid production of unconsciousness and immobilization with no traumatic or troublesome induction phenomena.

2. Very large safety margin and low organ and tissue toxicity.

3. Simple method of administration without the need for special equipment or restraint beyond that afforded by the common primate "squeeze" cage.

4. No special preparation of the animal required (i.e. emptying the stomach), protective reflexes maintained, and no impairment of respiratory or cardiovascular function.

5. Adequate warning of impending emergence, but relatively rapid and uneventful recovery with no behavioral, pharmacological or biochemical residuals.

6. Good control over the duration of incapacitation produced.

7. No tolerance or dependence with repeated administration.

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[1]The data for this paper were collected in the laboratories of Prof. Karl H. Pribram, Department of Psychiatry, and Dr. James H. Dewson, III, Division of Speech and Hearing Sciences.

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8. Pharmacological compatibility with commonly used general anesthetic and pre-anesthetic agents.

9. Analgesic properties.

A wide variety of approaches to pharmacological restraint have been advocated, including sedation with oral or parenteral barbiturates, administration of tranquilizers, use of neuromuscular blocking agents, and induction of general anesthesia with gaseous or volatile agents introduced into a gas-tight enclosure. Each of these techniques approximates a different subset of the desired properties, but generally measures up quite poorly on several others. Until recently, the only agent available that exhibited a "wide spectrum" of these characteristics in nonhuman primates was phencyclidine (Sernylan; Phillips, Roxane Inc., Saint Joseph, Missouri) administered by intramuscular injection. Although a quantile improvement over previous approaches, phencyclidine possesses three properties that make it less than ideal in some situations.

1. Relatively long recovery time (ranging up to three hours in *Macaca mulatta*) with the lowest effective dose and corresponding poor control over the duration of effect. This is a nuisance when only a few minutes of restraint are required.

2. In most species at the usually employed dose levels (1-3 mg/kg in *M. mulatta*) anesthesia with unconsciousness and analgesia are not produced. Rather the animal is in a cataleptoid condition, but presumably "aware" of external stimulation and at least partially responsive to painful stimuli[2]. This represents a hazard with inexperienced persons who may confuse a state of immobilization with anesthesia. At higher doses, seizures are sometimes produced (Domino, McCarthy, & Deneau, 1969; Spalding & Heyman, 1962).

3. Human clinical trials with phencyclidine were discontinued because of both acute and persisting psychological effects observed in some subjects, including vivid hallucinations and prolonged amnesia (Greifenstein, DeVault, Yoshitake, & Gajewski, 1958). These data are somewhat disturbing to investigators conducting social, neurobehavioral, or neurophysiological studies.

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[2]There is considerable disagreement over the nature of the state produced by phencyclidine and whether or not monkeys are "conscious" while under its influence. In most cases in man, there is amnesia after recovery for events occurring during the drug period even when the subject appears to be partially aware and interacting with his environment during the procedure. Although present, analgesia is not as pronounced in *M. mulatta* as in man, and we prefer to adopt a conservative viewpoint and restrict the use of phencyclidine alone to completely non-painful procedures.

A close structural relative of phencyclidine, designated "ketamine" (CI-581, Ketalar, Ketaject, Vetalar; Parke, Davis, and Co., Detroit, Michigan), has recently come into use in human and veterinary anesthesia and does not appear to possess the disadvantages encountered with phencyclidine while retaining the desirable characteristics. This paper is a report of our initial experiences with ketamine anesthesia in 86 macaque monkeys. Three species were used, 67 *M. mulatta* (rhesus), 8 *M. arctoides* (stumptails), and 11 *M. fascicularis* (cynomolgus). There were a total of 137 anesthetic periods, 112 with *M. mulatta*, 14 with *M. arctoides*, and 11 with *M. fascicularis*. A short review of the chemistry and animal pharmacology of ketamine has been published (McCarthy, Chen, Kaump, & Ensor, 1965).

All procedures were conducted with Ketaject which is supplied as the hydrochloride in a concentration equivalent to 50 mg/cc of the ketamine base. Ketamine is also available in a concentration of 10 mg/kg and as a veterinary product containing 100 mg/cc.

Procedure

With the exception of early trials with ketamine in which the intravenous and intra-peritoneal routes were evaluated, induction has always been accomplished according to a standard procedure for intramuscular injection. Monkeys not singly housed are "lured" or transferred to a squeeze cage and allowed to acclimate for a short period of time; individually caged animals are anesthetized in their home cage. The animal is then forced to the front of the cage and the desired dose injected into the gluteal or deltoid muscle. Ketamine is relatively nonirritating to tissues and accidental sub-cutaneous injection does not appear to produce any unfortunate sequelea other than a slightly delayed onset of action. Aspiration of the syringe prior to injection, however, is advisable to preclude the possibility of inadvertent intravascular injection. Onset of action is so rapid by the I.M. route and the safety margin sufficiently large that in most instances the difficulties of I.V. administration outweigh any benefits obtainable. Following a single I.M. injection, of a supra-threshold dose, relaxation of the facial muscles and marked nystagmus (usually vertical) develops in 1-2 minutes. A gradual cessation of body movements supervenes and the animal "sinks" to the floor of the cage. Surgical anesthesia is achieved in 2-7 minutes ($\bar{X}$ = 4.1, S.D. = 1.2) and is indicated by a complete cessation of eye movements. The eyes remain widely open and fixed, corneal and light reflexes are active but slowed, and analgesia and a degree of skeletal muscle relaxation are present. Occasionally salivation and lacrimation occur, but this seldom constitutes a serious problem as the pharyngeal and laryngeal reflexes remain intact even at deep planes of ketamine anesthesia. If desired, these excessive secretions can sometimes be prevented with .05 mg/kg atropine I.M. or S.C. Other autonomic signs with ketamine are not grossly apparent.

We have not experienced induction excitement with the exception

of a mild ataxia and rolling motion of the head. At clinically employed dosage levels, there is no observable effect on respiration although polypnea sometimes persists for a short time if the animal has been stressed immediately prior to induction. Blood pressure is not routinely monitored in this laboratory, but no obvious hypotensive effects have been observed even when employed in the presence of mild hemorrhagic shock. Four test measurements with a pediatric cuff indicated a small (approximately 10 mm Hg) depressor effect on both systolic and diastolic pressures. This is consistent with data from studies of cardiovascular effects of ketamine in the rhesus monkey (McCarthy, Chen, Kaump, & Ensor, 1965). Body temperature falls slightly during the anesthetic period unless steps are taken to conserve heat. Convulsions, occasionally reported (Domino, McCarthy, & Deneau, 1969) with extreme doses of phencyclidine have not been observed or reported in the literature for nonhuman primates, although tonic-clonic seizure-like activity (without EEG signs of seizure) have been observed in man (Wilson *et al.*, 1967; Corssen & Domino, 1966).

Duration of Anesthesia

The relationship of dose to duration of anesthesia for a single I.M. injection is shown in Table 1. Duration of anesthesia is defined

Table 1

Mean Duration, Range of Durations, and Recovery Time (All in Minutes) for Ketamine Anesthesia Following a Single I.M. Injection

Dose (mg/kg)	No. Animals	No. Anesth. Periods	Mean	Range	Recovery Time
5[a]	7	7	5	3-7	10-20
8	8	9	16	13-19	25-27
10	22	49	25	18-27	21-30
15	19	31	38	30-46	32-50
18	8	11	41	32-46	45-56
20	10	11	45	35-47	45-60

[a]Produced only partial immobilization in three monkeys. Did not meet criteria for anesthesia.

here as the time from injection to the return of eye movements and/or voluntary movements of the extremities. No animal was anesthetized more than once in any one month. These data correspond closely to that of Bree (1967). The threshold dose for the production of surgical

anesthesia was 8-10 mg/kg ($\bar{X}$ = 8.5). With I.V. administration the threshold is lowered to about 5 mg/kg and the entire dose-effect curve is shifted downwards.[3]

Extension of Anesthesia-Supplementary Doses

Procedures of up to two hours' duration have been performed in these laboratories with repeated doses of ketamine as the sole anesthetic agent. Fifty to 100 percent of the original dose given I.M. at the first signs of emergence from surgical anesthesia (return of eye movements) will extend the period in accordance with the dose/duration curve for an initial I.M. injection. Our experience confirms reports that ketamine exhibits virtually no cumulative effects over periods of several hours in healthy young monkeys. The maximum total dose administered during any one anesthetic period was 70 mg/kg. If the need for repeated supplementary doses is probable, more control is afforded by the I.V. route. The syringe can be taped to the limb with the needle left *in situ* or a polyethylene catheter (Intrafusor, 19 ga.; American Hospital Supply Co., Evanston, Illinois) inserted. Forty to 80 percent of the original I.M. dose is administered slowly (over 60 seconds) for each additional period.

Recovery

The visible signs of recovery generally follow a sequence the reverse of that observed during induction. A return of eye movements is a reliable sign of impending emergence from surgical levels of anesthesia, and is followed by movement of the extremities, swallowing, and protrusion of the tongue, dilatation of the pupil, return of "awareness", and attempts to rise. The range of recovery times for different dose levels is shown in Table 1. For purposes of tabulation, recovery time was measured from injection to the point at which the monkey first supported its body with its forelimbs. The animals required approximately 20 minutes beyond this point to regain reasonably good coordination. This contrasts with the longer periods, often exceeding one hour, required to reach this stage when using pentobarbital anesthesia. Nystagmus often persists well into the recovery period and human clinical experience (Wilson *et al.*, 1967) indicates that considerable analgesia is also present after the end of anesthesia. Gross behavioral effects disappear within three to four hours. No glaringly obvious changes in performance on a variety of behavioral tasks have been noted 24-48 hours post anesthesia, but until properly designed studies are conducted, the question of short and long term effects on behavior remains open. Humans anesthetized with ketamine do not show detectable behavioral changes following recovery (Wilson *et al.*, 1967; Corssen & Domino, 1966).

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[3]In accordance with good practice, all I.V. injections were performed over a period of not less than 60 seconds to allow dilution in the total plasma volume.

Emergence Complications

No serious complications have been encountered during emergence from ketamine. Shivering accompanying a fall in body temperature has been observed following long procedures. Cautious use of a heat lamp and coverings are all that is necessary.

Emergence excitement with struggling, premature attempts to stand and head banging have occurred in three animals recovering from ketamine anesthesia. It appears to be a reaction peculiar to the particular individuals and was also observed during emergence from phencyclidine in these animals. It can be minimized by avoiding tactile and auditory stimulation after the loss of surgical anesthesia and we have successfully eliminated these untoward reactions entirely with 1 mg/kg of promazine (Sparine; Wyeth, Philadelphia, Pa.) I.M. Promazine is most effective if administered before excitement is present and we make it routine procedure to use it prior to recovery in monkeys known to have emergence problems (unless contraindicated for medical or experimental reasons). We have experienced no respiratory problems during emergence and emesis was not observed in this series.

Quality of Anesthesia

At doses of less than about 9 mg/kg, ketamine produces a cataleptoid condition (similar to that of phencyclidine) in most monkeys, characterized by incapacitation, nystagmus, protrusion of the tongue, swallowing, and rhythmic motions of the extremities. Generalization from human data (Wilson *et al.*, 1967) suggests that the animal is "aware" of his surroundings, but considerable analgesia is present. This state is suitable for non-painful procedures (such as tuberculin testing, suture removal, etc.) or minor surgical procedures if infiltration or nerve block with a local anesthetic is employed. However, it should be remembered that although the perception of pain is obtunded, the state or manipulations performed during this time might be extremely aversive or frightening to the animal. Unless there is an overriding reason to employ only minimal amounts of anesthetic, it would seem a better policy to use doses insuring a loss of consciousness. At useful supra-threshold doses, the primary effect of dosage is on the duration and not the quality of anesthesia. Throughout a wide range of doses, the animal is immobile, the eyes are open and fixed straight ahead, and some skeletal muscle relaxation is present. As stated earlier, pharyngeal, laryngeal, corneal and light reflexes remain intact. The primary sign of the presence of surgical anesthesia is the *complete cessation of eye movements*. This level is reportedly suitable for most surgical procedures not involving stimulation of visceral pain pathways or the pharyngeal-laryngeal areas (McCarthy, Chen, Kaump, & Ensor, 1965; Bree, 1967). Our own experience has been confined to wound repair, drainage of abscesses, amputation of digits and tail, diagnostic studies, and cranial burr holes for electrode implantation. Skeletal muscle relaxation is not good, small movements may occur and the level of anes-

thesia requires continual monitoring because of the short action of the drug and the cataleptoid phase that may mask signs of insufficient depth of anesthesia. In addition, some individuals find the "awake" character of the animal unsettling and prefer an anesthetic agent that produces the classically "asleep" subject for major surgical interventions. For these reasons, ketamine alone is probably best confined to relatively minor operations on the extremities or head of less than one-hour duration. For elective surgery, pre-operative fasting and preparation will leave the option of employing supplemental general anesthetic agents. Within these limits, ketamine produces excellent results with exceptional safety.

Safety

Critical values for ketamine HCl in *Macaca mulatta* have been reported (McCarthy, Glazko, & Kurtz, 1970) to be as follows:

Minimum Effective Dose (MED)--5 mg/kg I.M.; 3 mg/kg I.V.
Minimum Toxic Dose (MTD)--45 mg/kg I.V. (Toxicity defined as significant respiratory depression.)
Minimum Lethal Dose (MLD)--50 mg/kg I.V.

All I.V. injections were made over a period of not less than 60 seconds. The resulting Therapeutic Ratios are: MTD/MED = 15; MLD/MED = 16. These data rank ketamine as among the safest known general anesthetics available for nonhuman primates. In this series of animals there was no mortality and no incidents in which it was felt an animal was in any danger. In fact, no difficulties were encountered other than mild salivation and the emergence reaction described previously. It would seem virtually impossible to kill an animal with ketamine if an adequate airway and body temperature are maintained (excluding the possibility of idiosyncratic reactions). Death from respiratory and cardiac failure are reported at doses in excess of 48 mg/kg by I.V. injection (McCarthy, Chen, Kaump, & Ensor, 1965; Bree, 1967). It is our belief that ketamine is a safe agent for use in injured animals that *must be anesthetized*, although there is not sufficient data to recommend its use with severely traumatized or debilitated monkeys.

Species and Sex Differences in Response

Satisfactory anesthesia was produced in all three macaque species. The duration of anesthesia at a given dose level was slightly greater for *M. fascicularis* than for either *M. mulatta* or *M. arctoides*. These animals, however, tended as a group to be both older and considerably more obese so it is difficult to speculate on the reasons for this variation in response. The differences are not likely to be important clinically and data was pooled across species for purposes of tabulation.

No significant differences in response between males and females were noted for any of the three species.

All monkeys were between the ages of 1.5 and 9 years and weighed between 1.9 and 15 kg. No important differences in response between age groups were noted, but we have no information on very young or old animals.

Interaction with Other General Anesthetics

Ketamine is compatible pharmacologically (although not always chemically) with the injectible barbiturates and inhalational agents in common usage in monkeys, and one of its major uses in our laboratory is the induction of basal anesthesia prior to maintenance with pentobarbital or thiamylal (Surital; Parke, Davis, & Co., Detroit, Michigan). The monkey is anesthetized by an I.M. injection of ketamine at a dose of 10 mg/kg according to usual procedure. A slow intravenous infusion of dilute (30 mg/cc for pentobarbital) barbiturate is begun and continued until the corneal reflex is abolished and respiration is deep and regular. The amount of barbiturate required after ketamine is 50% to 75% less than when these agents are employed alone and the dose must be titrated to the individual's response. I.P. administration of a fixed dose is a particularly hazardous procedure, as the variable response to two drugs is involved. It should be stressed that the precuations necessary for barbiturate anesthesia are in order for the combined technique. Fasting for at least eight hours pre-operatively is mandatory and personnel should be prepared to assist respiration if necessary and monitor the animal during the recovery period. The I.V. injection of barbiturate should be made slowly with frequent pauses to assess the effect. The quality of anesthesia produced with ketamine-pentobarbital is excellent and possesses the following important advantages over pentobarbital alone:

1. The animal is initially anesthetized safely in his home cage by I.M. injection. There is no need for manual restraint for venipuncture with its attendant struggling, stress and risk of injury (to both monkey and man). Induction is smooth and can be accomplished by one person.

2. The weak analgesic properties of barbiturates are augmented by ketamine and satisfactory surgical anesthesia is produced with less barbiturate and consequently less respiratory and cardiovascular depression. Muscular relaxation is adequate for most procedures.

3. The duration of anesthesia is shortened relative to the minimal period obtainable with pentobarbital alone; hence the complications and inconvenience of prolonged recoveries are avoided. Table 2 compares the duration of pentobarbital anesthesia with and without prior administration of ketamine. Each animal was anesthetized once. Intravenous injections of pentobarbital were given over a period of not less than three minutes.

4. Recovery is smoother with less excitement and struggling. This is possibly due to a persistence of ketamine analgesia after consciousness is regained. Requirements for analgesics in the immediate post-operative period may be reduced in some instances. Table 2 shows recovery time, as measured from administration of pentobarbital, with and without prior administration of ketamine.

Table 2

Mean Duration, Range of Durations, and Recovery Time (All in Minutes) for Pentobarbital Anesthesia With and Without Prior Administration of Ketamine (10 mg/kg I.M.)

Prior Conditions	Dose (mg/kg)	No. Animals	Mean	Range	Recovery Time
Ketamine Used	4[a]	5	17	14-24	40-41
	5	4	25	24-27	45-47
	6	4	40	37-43	60-71
	8	6	76	74-85	83-94
Ketamine Not Used	18-19[b]	17	26	24-28	61-100
	20-21	11	35	30-50	80-120
	22-23	18	47	46-50	125-136
	24-25	12	64	57-70	180-215
	35-36	6	123	120-200	240-376

[a]Two monkeys were not anesthetized deeply enough to abolish the corneal reflex at this dose level.

[b]Fourteen monkeys were not anesthetized deeply enough to abolish the corneal reflex at this dose level. Anesthesia was inadequate.

Small doses of ketamine have also been found useful in extending previously induced barbiturate anesthesia. This technique is advantageous when a short additional period of surgical anesthesia is required and it is undesirable to administer more barbiturate or veins are inaccessible because of drapes, depressed blood pressure, etc. 1 mg/kg I.M. given at the point of return of the corneal reflex will extend surgical anesthesia for approximately 10 to 30 minutes. Recovery also tends to be smoother with less struggling and vocalization.

Summary and Conclusions

Ketamine was evaluated as a general anesthetic and immobilizing agent in three species of macaques. It was found valuable for (1) non-

painful diagnostic or experimental procedures, (2) minor surgery, (3) induction of general anesthesia prior to maintenance with a barbiturate, and (4) extension of barbiturate anesthesia. No fatalities or significant complications were experienced and no long-term effects have been noted. It was felt to be less useful as the sole agent in major or long surgical interventions.

Desirable characteristics include rapid and reliable action by the I.M. route, minimal effect on protective reflexes, smooth and quiet induction, lack of cumulative effects, wide safety margin, rapid recovery and low organ toxicity. It would seem particularly indicated when anesthesia must be conducted with minimal equipment by relatively inexperienced persons, in emergency procedures (when the stomach is not empty and minimal depression of vital functions is essential), for routine procedures where safety is the prime concern and only immobilization is required, and in large or uncooperative animals where other techniques are difficult.

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OBSERVATIONS ON DENTAL DEPOSITS AND DEFICIENCIES OF WILD TALAPOIN MONKEYS (*CERCOPITHECUS TALAPOIN*) COLLECTED IN RIO MUNI, WEST AFRICA*

Clyde Jones

National Museum of Natural History

Discolorations and deposits of calculus on teeth and caries have been reported for numerous species of wild mammals, but wild primates seem to be particularly prone to these conditions (Johansen, 1968). A tabulation of diseased teeth and jaws of marmosets was presented by Hershkovitz (1970). Earlier, Schultz (1935) studied eruption and decay of permanent teeth of primates. The teeth of *Cercopithecus talapoin* were pictured and described in detail by Warwick James (1960), but, to my knowledge, no information has been published on the susceptibility of the teeth of wild animals of this species to deposits of materials and their sequelae.

Information made available in recent years on several aspects of the biology of this species, reviewed briefly by Cooper and King (1968), has stimulated interest in their potential utility in several kinds of biomedical and behavioral research (Cooper & King, 1968; Schrier & Povar, 1968). The importance of basic information about deposits on teeth with regard to efficient care and maintenance of primates in captivity was recognized by Chase and Cooper (1968), who recommended the examination of teeth and removal of calculus, as well as deposits of soft materials, as prophylactic measures for oral hygiene of captive primates.

The purpose of this report is to record and discuss briefly the incidence of deposits of tartar and calculus, as well as corresponding sequelae, on teeth of wild *C. talapoin* collected in Rio Muni, West Africa.

Data on deposits of materials on teeth and related or resultant abnormalities of the teeth and jaws were obtained from examinations of preserved heads and skulls of 29 specimens (22 females, 7 males) of talapoin monkeys. Specimens were gathered from February, 1967, through June, 1968, at several localities in Rio Muni. Animals were either shot or caught in snares set by local trappers. The specimens from which these data were obtained were deposited in the Vertebrate Collections of Tulane University.

The data presented herein were taken from specimens considered

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*Materials utilized in this study were obtained in Rio Muni while the author was conducting field studies of primates supported by the National Geographic Society and Grant No. FR00164 from the National Institutes of Health.

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as adults in that all permanent teeth were completely erupted and body weights of the animals exceeded 0.9 kg.

For the purposes of this report, deposits of hard materials on teeth were identified by the following terms:

Tartar--stains and dark incrustations found on crowns of teeth in supragingival areas.
Calculus--white concretions found on crowns of teeth in either supragingival or subgingival regions.

The data for the two sexes were separated because considerable differences in the incidence of dental problems were noted.

Tartar occurred with nearly equal frequency on maxillary and mandibular teeth (Table 1). For females, the greatest incidence of

Table 1

Incidence of Tartar On Teeth of Wild Talapoin Monkeys.

Sex	Dentition	Maxillary Left	Maxillary Right	Mandibular Left	Mandibular Right	Total
Female	I 1	2	1	0	0	3
	I 2	0	0	0	0	0
	C	1	2	1	2	6
	P 1	6	2	3	1	12
	P 2	3	3	3	2	11
	M 1	3	3	6	5	17
	M 2	2	4	5	4	15
	M 3	7	5	6	5	23
	Total	24	20	24	19	87
Male	I 1	1	1	1	1	4
	I 2	1	1	1	1	4
	C	1	1	0	1	3
	P 1	1	2	1	1	5
	P 2	0	0	0	0	0
	M 1	0	0	0	0	0
	M 2	0	0	0	0	0
	M 3	1	1	0	1	3
	Total	5	6	3	5	19

these deposits was on the back teeth (premolars, molars) with most discoloration noticed on the third molars. For males, the greatest incidence of tartar was on the front teeth (incisors, canines, first premolars), particularly on the first premolars.

Calculus was found on maxillary and mandibular teeth, but more was present on the upper teeth than on the lower teeth (Table 2). For

Table 2

Incidence of Calculus On Teeth of Wild Talapoin Monkeys.

Sex	Dentition	Maxillary Left	Maxillary Right	Mandibular Left	Mandibular Right	Total
Female	I 1	0	0	0	0	0
	I 2	1	1	0	0	2
	C	1	1	2	1	5
	P 1	1	6	3	3	13
	P 2	3	3	3	3	12
	M 1	5	7	4	3	19
	M 2	7	4	4	3	18
	M 3	1	3	2	2	8
	Total	19	25	18	15	77
Male	I 1	0	0	0	0	0
	I 2	0	0	0	0	0
	C	1	0	0	0	1
	P 1	0	1	0	1	2
	P 2	0	1	0	0	1
	M 1	3	2	0	0	5
	M 2	1	0	0	1	2
	M 3	0	0	0	0	0
	Total	5	4	0	2	11

both sexes, calculus occurred mostly on the back teeth (premolars, molars); the first molar was the site of most of the calculus observed. Maxillary teeth exhibited more dental deposits than mandibular teeth in the nine species of captive primates examined by Chase and Cooper (1968), who noted calculus mostly on maxillary canines and first premolars. In addition, these authors discussed the occurrence of calculus in various places in the mouths of captive monkeys and showed that deposition of calculus was not symmetrical on both sides of the mouth.

Periodontal disease was observed in females, but not in the males examined here (Table 3). In females, it occurred with about equal frequency in association with the upper and lower teeth. Hershkovitz (1970) also found little difference in the proportions of diseased upper and lower teeth of marmosets.

Alveoli replaced by bone as a result of loss of teeth were observed in the maxillae and mandibles of the female specimens of *C. talapoin* (Table 4).

Table 3

Incidence of Periodontal Disease in Wild Talapoin Monkeys.

Dentition	Maxillary		Mandibular		Total
	Females	Males	Females	Males	
I 1	1	0	0	0	1
I 2	2	0	0	0	2
C	2	0	2	0	4
P 1	0	0	4	0	4
P 2	3	0	4	0	7
M 1	3	0	6	0	9
M 2	4	0	5	0	9
M 3	4	0	4	0	8
Total	19	0	25	0	44

Table 4

Incidence of Alveoli Replaced by Bone in Wild Talapoin Monkeys

Dentition	Maxillary		Mandibular		Total
	Females	Males	Females	Males	
I 1	0	0	4	0	4
I 2	3	0	4	0	7
C	0	0	2	0	2
P 1	3	0	3	0	6
P 2	3	0	3	0	6
M 1	2	0	2	0	4
M 2	0	0	2	0	2
M 3	0	0	2	0	2
Total	11	0	22	0	33

The loss of teeth was more common on the lower jaws than on upper jaws. Loss of teeth most frequently involved the second incisors and the premolars. Evidence of loss of teeth was not found in the male specimens. Other workers have also reported tooth loss in primates. For example, deficiencies of teeth for five species of *Cercopithecus* were listed by Hill (1966); third molars were absent most often, but premolars and incisors were lacking occasionally. Some deviations from the normal permanent dentition, as well as decay and loss of teeth, of primates were described and illustrated by Schultz (1935) and Hershkovitz (1970).

One skull of a male talapoin exhibited a supernumerary tooth, perhaps

a nonexfoliated deciduous tooth. This small tooth was located on the outside of the row of teeth of the right mandible, positioned between the second incisor and canine. Extra teeth were rare in most other primates studied (Hershkovitz, 1970; Schultz, 1935).

Considerable differences were apparent between male and female talapoin monkeys with regard to the incidence of deposits of materials on teeth and associated dental problems (Table 5); 34.3 percent of the

Table 5

Percentage of Teeth with Dental Deposits and Associated Problems in Wild Talapoin Monkeys.

Sex	Teeth Examined	Type of Problem			
		Tartar	Calculus	Periodontal Disease	Replaced Alveoli
Females	704	12.36	10.94	6.3	4.7
Males	224	8.5	4.9	0	0

teeth of females exhibited either deposits of materials or periodontal disease and loss of teeth, but only 13.4 percent of the teeth of males carried deposits of materials. Inter- and intra-specific variations in oral conditions of several species of mammals were mentioned by Gustafsson (1968), who discussed briefly the correlations between susceptibility, as well as resistance, to dental caries and genetic factors.

Differences observed here between males and females in the incidence of deposits of tartar and calculus on teeth, as well as related oral diseases and loss of teeth, may have reflected differences in ages of the animals studied. Considerable wear was evident on teeth for both sexes, but the teeth of females exhibited generally more wear than teeth of males. Incisors of one female specimen did not occlude because of wear at the tips of these teeth. Because of extensive wear and corresponding malocclusions, or the converse, cusps were nearly obliterated for most teeth in another female specimen. For discussion of the incidence of dental diseases in relation to age of wild primates, see Hershkovitz (1970) and Schultz (1935).

According to Johansen (1968), variations in incidence of dental problems among wild primates were correlated with differences in dietary habits; primates with diets rich in monosaccharides and disaccharides (fruits) had more dental problems than primates with diets containing mostly polysaccharides (leaves). Limited information on natural diets of wild talapoin monkeys (Gautier-Hion, 1966; Jones, 1970), has not suggested differences between the sexes. However, slight differences in diets may occur between males and females because of certain differences

in habits of the animals. For example, males may enter relatively open areas less than females to obtain such food materials as sugar cane, ground nuts, and manioc.

On the basis of data assembled on the incidence of dental caries in primates, Johansen (1968) observed that the occurrences of dental caries were intensified with exposures to civilization. In Gabon, talapoin monkeys inhabited secondary vegetation and consumed leaves, shoots, pith, insects, and large amounts of manioc (Gautier-Hion, 1966). In Cameroun, this species of *Cercopithecus* was observed in secondary vegetation close to farms and villages and was recognized as a pest to agriculture (Cooper & King, 1968). As in Gabon and Cameroun, wild talapoin monkeys studied in Rio Muni ranged in fields and adjacent secondary vegetation (Sabater Pi & Jones, 1967); natural diets included leaves, insects, and crop plants such as sugar cane and ground nuts (Jones, 1970). The seemingly high susceptibility of talapoin monkeys to deposits of materials on teeth, periodontal disease, and loss of teeth may have reflected the ecological distribution of this species in areas influenced greatly by man and the corresponding utilization of certain crop plants for food by the monkeys.

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PRIMATE ZOONOSES SURVEILLANCE REPORT NUMBER 7

These reports, issued by the Center for Disease Control, Atlanta, Georgia, summarize information about naturally occurring disease in nonhuman primates and their handlers. The information is received from selected centers that utilize large numbers of primates and from other organizations. The information is intended primarily for the use of the participating institutions and for others with responsibility for the care of nonhuman primates. Much of the information is preliminary in nature.

As in the past reports, the summary section (I) is followed by a section (II) on Surveillance Data which includes a subsection (A) on types of diseases and their frequencies for the period covered and one (B) on disease associated with contact with nonhuman primates. The report concludes with a section (V) of appendices organized as follows: (1-4) Nonhuman primate morbidity and mortality by reporting period, by length of time in colony, by age group, and by species group. (5-8) Nonhuman primate mortality by reporting period, by length of time in colony, by age group, and by species group. (9) Nonhuman primate population at the reporting centers.

The remaining contents of *Report Number 7* are as follows, with short summaries included where we deemed the items of special interest:

III. Case Reports

A. Chimpanzee-associated hepatitis in a woolly monkey. (Reported by R. McCollum, Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, Connecticut)

Several episodes of human hepatitis associated with woolly monkeys were reported in the early 1960's. For this reason, the occurrence of hepatitis in a woolly monkey related to an outbreak of chimpanzee-associated

hepatitis is of particular interest.

During the investigation of an outbreak of human hepatitis associated with chimpanzees in Connecticut, a number of other nonhuman primates housed in the same area as the chimpanzees and handled by the same employees were kept under observation. Serum enzyme levels and liver biopsies were obtained from several different monkey species, but only one animal, a male woolly monkey (*Lagothrix lagothica*), developed hepatitis.

While there is no unequivocal evidence that the hepatitis in the woolly monkey was due to the agent producing the chimpanzee-associated hepatitis cases, the possible spread of the hepatitis agent between multiple primate species should be considered in epidemiologic studies of nonhuman primate associated hepatitis.

B. Excessive mortality in a group of rhesus monkeys associated with delay in transit. (Reported by P. C. Hangleiter, Laboratory Animal Breeding and Holding Unit, Center for Disease Control, Atlanta, Georgia)

Improved transportation has been a major factor in reducing morbidity and mortality in newly imported monkeys. The current practice of shipping rhesus monkeys in the baggage compartments of passenger jet airplanes has minimized the stress and spread of disease in animals which are closely confined in shipping crates. However, a breakdown in the transportation system can have serious results. Experience with a recently imported group of rhesus monkeys serves as an example of the problem.

Normally, rhesus monkeys arrive at the CDC approximately 36 to 48 hours after being placed in their shipping crates in New Delhi, India. In November 1971, a shipment of 100 rhesus monkeys was delayed 5 days enroute at the London airport due to an airline-personnel strike. As a result, the monkeys were confined in their crates approximately 8 days prior to arrival at CDC.

A total of 57 animals in this shipment died. The heaviest mortality occurred in the first 2 weeks post-arrival during which time 69 percent of the fatalities occurred. Diarrheal disease and/or pneumonia accounted for 47 (82.5 percent) of the 57 fatalities.

Clinical signs of measles (rubeola) were observed in approximately 60 percent of the monkeys toward the end of the second week. Pneumonia complicated some of these infections.

A 10 percent mortality rate is normally anticipated in a newly arrived group of rhesus monkeys, and the excessive mortality in this shipment was undoubtedly due for the most part to the prolonged confinement of the animals in their crates during shipment. Temporary deprivation of water and a nutritionally marginal diet during the delay were probably contributing factors.

The delay in London was unavoidable under present circumstances as it was caused by a wild-cat strike. However, at airports such as the London Airport which play a key role in the trans-shipment of nonhuman primates, either provisions should be made for moving these animals despite strikes, or adequate housing and care should be provided during delays caused by such disruptions. The need for conservation and humane

treatment of these animals dictate that they be handled differently than ordinary freight.

C. Spontaneous malaria and babesiasis in chimpanzees. (Reported by A. J. Sulzer, U.S.G. Kuhn, & J. R. Broderson, Center for Disease Control, Atlanta, Georgia)

Findings demonstrate the need to be alert to the possibility of occult blood parasite infections in experimental studies involving splenectomy or immuno-suppression of nonhuman primates. Preliminary evidence indicates that serologic screening with indirect fluorescent antibody tests may be of value in selecting animals for such experiments.

IV. Special Reports

A. Measles and rubella antibody in nonhuman primates. (Reported by S. S. Kalter & R. L. Heberling, Division of Microbiology and Infectious Diseases, Southwest Foundation for Research and Education, San Antonio, Texas)

While serologic surveys indicate that rubella and measles antibodies are present in nonhuman primates with some frequency, the majority of these data were derived from examination of sera from captive animals, and only limited information is available regarding the prevalence of these infections among nonhuman primates in their natural habitat. Available evidence does indicate that these diseases are uncommon in wild animals and that these animals acquire their infections after capture and exposure to man. The low prevalence of measles antibody in New World monkeys generally and the relatively high prevalence of rubella antibody in chimpanzees and orangutans raise the question of whether a species or geographic distribution in susceptibility exists.

See the October, 1970, April and July, 1971, and January, 1972 issues of this *Newsletter* for previous reports.

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MACAQUES AVAILABLE FOR RESEARCH USE

Up to 300 rhesus (*Macaca mulatta*), cynomolgus (*M. fascicularis*), and bonnet monkeys (*M. radiata*) are available free of charge for immediate research use. They are 1-4 years of age, male and female, and have been isolator-reared in a modified germ-free environment. Some of these animals may show behavioral abnormalities traceable to rearing conditions.--Contact: Dr. Roy Kinard, National Cancer Institute, Federal Building, Room 504, Bethesda, Md. 20014. (Telephone: 301-496-6086)

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GREATER GALAGOS FOR SALE

Three laboratory-born male greater galagos (*G. crassicaudatus*), age 1 yr., and one adult female, age and background unknown. Price: $100 each.--Contact: A. Ehrlich, Calif. State College at Los Angeles, 5151 State College Drive, Los Angeles, Calif. 90032. (Telephone: 213-224-3848 or 213-224-3841)

RECENT BOOKS AND ARTICLES*
(Addresses are those of first authors)

BOOKS

Conservation of nonhuman primates in 1970. Harrisson, Barbara Basel: Karger, 1971. (*Primates in medicine*. Vol. 5) [Price: $6.70]

This report attempts to evaluate the problem of conservation of nonhuman primates mainly from data referring to the past five years. It describes, firstly, the situation of nonhuman primates in the tropical areas where they occur: the continents of Latin America and Africa, South Asia and Southeast Asia--with special reference to species most under pressure. Secondly, the aspect of usage is considered. Broad areas of biomedical research and industrial interest are identified and dealt with in some detail where they refer to endangered species and possible alternatives to present methods of production. The pet trade, its justification and abuses, is outlined. The research community has expressed its concern in efforts to promote laboratory breeding and in publishing individual or corporate concern. These actions have produced awareness of the complexities of the problem in a minority. It is the object of this paper to provide a wider view so that obvious issues can be acted on. Short-term and long-term aspects of primate conservation will need funding and detailed study to become effective. The pharmaceutical industry and the research community, depending on a continued availability of the whole spectrum of nonhuman primates, have a commitment and duty to act.

Cognitive processes of nonhuman primates. Jarrard, L. E. (Ed.) New York/London: Academic Press, 1971.

This book is based on the Sixth Annual Symposium on Cognition held at Carnegie-Mellon University in March, 1970. Contents: Short-term memory in the monkey, by L. E. Jarrard & S. L. Moise; Comparison of amnesic states in monkey and man, by L. Weiskrantz; Some general characteristics of a method for teaching language to organisms that do not ordinarily acquire it, by D. Premack; The habits and concepts of monkeys, by D. R. Meyer; The effects of deprived and enriched rearing conditions on later learning: a review,

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*In many cases, the original source of references in the following section has been the Current Primate References prepared by The Primate Information Center, Regional Primate Research Center, University of Washington. Because of this excellent source of references, the present section is devoted primarily to presentation of abstracts of articles of practical or of general interest. In most cases, abstracts are those of the authors.

by J. P. Gluck & H. F. Harlow; The effect of early adverse and enriched environments on the learning ability of rhesus monkeys, by H. F. Harlow, M. K. Harlow, K. A. Schiltz, & D. J. Mohr; Some differences between human and other primate brains, by N. Geschwind; Similarities in the cognitive processes of monkeys and man, by L. W. Gregg; Species differences in "transmitting" spatial location information, by R. C. Miles.

Proceedings of the Third International Congress of Primatology, Zurich 1970. Vol. 1: *Taxonomy, Anatomy, Reproduction.* Biegert, J., & Leutenegger, W. (Eds.) Basel: Karger, 1971. [Price: $22.80]

Chapter titles and authors listed under the various headings are as follows:

History.--The rise of primatology in the Twentieth Century, by A. H. Schultz.

Taxonomy, palaeontology.--The distribution of cranial capacity values among living hominoids, by P. V. Tobias; A canonical analysis of cranial dimensions, by N. Creel & H. Preuschoft; Systematics of the genus *Nycticebus*, by C. P. Groves; The question of locomotor differences in *Australopithecus*, by A. L. Zihlmann; Evolution of the siamang (*Symphalangus syndactylus*) in Southeast Asia during Pleistocene, by J. Kitahara-Frisch; Observations on the dryopithecines of India and Europe, by K. N. Prasad; Mode of locomotion in subfossil giant lemuroids from Madagascar, by H. Preuschoft.

Anatomy.--Evolutionary aspect of the primate neocortex, by F. Sandes; Beitrag zur Erfassung der progressiven Cephalisation bei Primaten, by H. Hemmer; Quantitative studies on the postnatal development of the central nervous system of *Cercopithecus aethiops*, by H.-J. Kretschmann, L. Schleifenbaum, & F. Wingert; Comparative studies on the fresh weights of the brains and spinal cords of *Theropithecus gelada*, *Papio hamadryas* and *Cercopithecus aethiops*, by A. Hopf & C.-P. Claussen; Einfache quantitative Untersuchungen an Herz, Leber und Milz einer postnatalen Reihe von *Cercopithecus aethiops*, by C.-P. Claussen & L. Schleifenbaum; The functional interpretation of the thumb in the hylobatidae, by R. Lorenz; Functional interpretation of the differences between primates with regard to the Musculus biceps femoris and Musculi vasti, by J. T. Stern, Jr.; Morphologie der Muskeln der tiefen Extensorenschicht des Fussrückens bei den nichthominiden Primaten, by A. Kaneff; A comparison between the facial muscles of catarrhini with long and short muzzles, by R. Seiler; Die Morphologie der symphysealen Gelenkfläche des Os pubis bei den Primaten, by M. Dokládal; A longitudinal study of the growth of the chimpanzee bony pelvis, by W. W. Barham; Comparison of the pelvic growth patterns of chimpanzee and man, by H. Coleman; Vorkommen und Verteilung der Vater-Pacinischen Körperchen im

Unterarm neonater Prosimier, by G. Altner; Zur vergleichenden Histologie von Haütdrusenorganen im Lippenbereich bei *Tarsius bancanus borneanus* Horsfield 1821 und *Tarsius syrichta carbonarius* Linnaeus 1758, by H. Sprankel; Comparative studies on the sublingual organ in primates: the sublingua in *Perodicticus potto* (primates, prosimiae, lorisiformes), by H. O. Hofer; Taxonomic and evolutionary trends evidenced in the microscopic anatomy of non-human primate head hair, by S. I. Rosen; Dimension und Querschnittsform der Kopfhaare von *Macaca mulatta*, by E. Reuer; Ontogenic changes of the cranial base in *Macaca mulatta*: histologic study, by Maria Micheida; Morphometry of ear bones of some New World primates, by M. Masali.

Reproduction,--Comparative aspects of reproduction in primates, by W. H. Niemann; A comparison of the early development of the fetal membranes of tupaiidae, lorisidae and *Tarsius*, and its bearing on the evolutionary relationships of the prosimian primates, by W. P. Luckett; Gonadal development in marmosets, by Suzanne H. Hampton & A. C. Taylor; Les cycles sexuels et reproducteur des Prosimiens africains de forêt. Eléments de comparaison entre le Congo-Brazzaville et le Cameroun, by François Vincent.

Proceedings of the Third International Congress of Primatology, Zurich 1970. Vol. 2: *Neurobiology, Immunology, Cytology.* Biegert, J., & Leutenegger, W. (Eds.) Basel: Karger, 1971. [Price: $21.60]

Chapter titles and authors listed under the various headings are as follows:

Neurobiology.--Evolution of the corticospinal tract in primates with special reference to the hand, by C. G. Phillips; The auditory cortex of the squirrel monkey: neuronal discharge patterns to auditory stimuli, by P. Winter & H. H. Funkenstein; Cerebrale Korrelate von Vokalisationen, by U. Jürgens; Behavioral and electrophysiological investigations of picture perception in rhesus monkeys, by Magda L. Marton, J. Szirtes, & J. Urbán; Evoked potentials to meaningful (self-produced) sounds in rhesus monkeys, by J. Szirtes & J. Urbán; Répartition de la photosensibilité dans plusieurs populations de babouins (*Papio papio*), by R. Naquet, J. Bert, & R. Guillon; Adaptation du sommeil aux conditions expérimentales d'enregistrement chez deux Cercopithecinae (*Papio papio* et *Macaca radiata*), by J. Bert; Sleep in the nocturnal primate, *Aotus trivirgatus*, by A. A. Perachio; De nouvelles données sur la sensibilité à la Phenil-Thio-Carbamide chez les primates, by R. Polcari.

Immunology.--The use of the anti-globulin inhibition test for serological studies in primates (sero-primatology), by W. Socha, Eve B. Gordon, Mollie Saltzman, & A. S. Wiener; Molecular evolution at the population level in higher primates,

by M. Goodman; Genetic affinities of *Macaca fuscata* Blyth 1875, by W. Prychodko & M. Goodman; The concept of histochemical perspective, by H.-J. Huser; Analysis of hematological data of nonhuman primates by means of the multiple linear regression model, by H.-J. Huser & A. Linder; The significance of 'diamine oxidase' and 'histaminase' values in New and Old World primates, by J. K. Hampton, Jr., Linda J. Rider, & Marian L. Parmelee.

Cytology.--New data for the comparison of the karyotype of the anthropoid apes with that of man, by B. Chiarelli; Mongoloid-like condition in a chimpanzee, by H. M. McClure, W. A. Pieper, M. E. Keeling, & C. B. Jacobson; The idiogram of different species of *Cercopithecus*, by Laura Lamberti & Luisella Barberis; Cytology of the cercopithecidae with special reference to the karyotype of *Cercopithecus hamlyni* Pocock 1907, by L. E. M. deBoer; The karyotypes of the baboon, by F. Fontana & B. Chiarelli; Chromosomal evolution in the Platyrrhini, by J. Egozcue & E. M. Perkins; Observations on the nuclear morphology of the spermatogenetic cells of *Tarsius syrichta*, by Maria Monchietto; The variations in nuclear genetic material content of lymphocytes in cytotaxonomic picture of primates, by Maria G. Manfredi Romanini; Nuclear areas and DNA content of lymphocytes in Hylobatinae, by Franca Porcelli; The nuclear DNA content, the nuclear areas and the amounts of total proteins in the lymphocytes from some species of South American monkeys, by F. Fontana; Nuclear area and DNA content of lymphocytes in *Tarsius syrichta* L., by Franca Porcelli.

Parasitology.--Use of nonhuman primates in experimental schistosomiasis haematobia (with color plate I), by R. E. Kuntz, Betty Myers, T. C. Huang, & J. A. Moore; Virus excretion from captive newborn baboons (*Papio cynocephalus*), by S. S. Kalter, R. L. Heberling, A. R. Rodriguez, & R. J. Helmke; Contribution à l'étude de l'ultrastructure de *Troglodytella abrassarti* Brumpt et Joyeux 1912, by J. M. Jadin, Julia Creemers, & J. Mortelmans; Three pathogenic intestinal protozoa of anthropoid apes: *Entamoeba histolytica, Balantidium coli* and *Troglodytella abrassarti*, by J. Mortelmans, J. Vercruysse, & P. Kageruka.

Medical primatology.--Biological parameters of simians for medical research, by Elizabeth Muchmore & J. Davis; Clinical conditions and diseases encountered in a large simian colony, by D. A. Valerio, Marion G. Valerio, B. M. Ulland, & J. R. M. Innes; Implantation of teeth in baboons, by J. E. Hammer, III; Pathological findings in the adrenal glands of the chacma baboon (*Papio ursinus*)--141 autopsies, by P. J. Price, H. W. Weber, J. Greeff, & J. J. Van der Walt; Teratogenicity of thalidomide in the baboon (*Papio cynocephalus*), bonnet monkey (*Macaca radiata*) and cynomolgus monkey (*Macaca irus*), by A. G. Hendrickx; The teratogeny of a thalidomide analog in rhesus monkeys, by W. P. McNulty, Jr., & H. M. Wuest.

Proceedings of the Third International Congress of Primatology, Zurich, 1970. Vol. 3: *Behavior.* Kummer, H. (Ed.) Basel: Karger, 1971. [Price $16.80]

Chapter titles and authors listed under the various headings are as follows:

Field studies on ecology and social structure.--Spatial relations within the siamang group, by D. J. Chivers; Social organization of a free-ranging troop of black and white colobus monkeys (*Colobus abyssinicus*), by Andrea Leskes & N. H. Acheson; Effects of altitude differences on group organization of wild black spider monkeys (*Ateles paniscus*), by N. M. Durham; Behavioral differences of *Presbytis entellus* in two different habitats, by C. Vogel; Social organization in a baboon hybrid zone, by U. Nagel; Social grouping and troop size in yellow baboons, by J. E. Cohen.

Structure and formation of semi-natural groups.--Agonistic behavior during group formation and intergroup interactions in sooty mangabeys (*Cercocebus atys*), by I. S. Bernstein; Group formation in preschool children, by W. C. McGrew & P. L. McGrew; Kinship interaction patterns in pigtail and bonnet macaques, by L. A. Rosenblum.

Determinants of social relationships.--Situational determinants of dominance in captive young gorillas, by A. J. Riopelle, R. Nos, & A. Jonch; Dominance testing of infant pigtailed monkeys reared in different laboratory environments, by G. D. Jensen, Ruth A. Bobbitt, & Betty N. Gordon; Factors influencing sexual behavior of male bonnet macaques (*Macaca radiata*), by R. D. Nadler & L. A. Rosenblum; Deprivation and enrichment in the development of primates, by W. B. Lemmon; Changes in mother-infant behaviour following changes in group composition in sykes and patas monkeys, by N. R. Chalmers; Influence of environment on development of mother-infant interaction in pigtail monkeys, by R. Castell & Carolyn Wilson; Perceptual factors in the development of filial attachment, by W. A. Mason, Suzanne D. Hill, & C. E. Thomsen.

Manipulation and learning.--Some remarks on the spontaneous use of the hand in the common marmoset (*Callithrix jacchus*), by H. Rothe; Differentiation of scribbling in a chimpanzee, by H. S. R. Glaser; Memory for form by monkeys, by R. T. Davis; The learning skills of *Pongo*, by D. M. Rumbaugh and T. V. Gill.

Physiological aspects of behavior.--Discrimination of the odor of males and females by the marmoset *Saguinus fuscicollis ssp.*, by Gisela Epple; Changes in heartrate during social organization of the squirrel monkeys (*Saimiri sciureus*, Iquitos), by D. K. Candland; Sexual climax in female *Macaca mulatta*, by Frances D. Burton.

Medical primatology 1970. Goldsmith, E. I., & Moor-Jankowski, J. (Eds.) Basel: Karger, 1971. [Price: $67.20]

This is the proceedings of the 2nd Conference on Experimental Medicine and Surgery in Primates held in New York City in 1969. Contents are as follows:

Man and nonhuman primates. Immunological response. --Immunological studies on the human response to chimpanzee tissue antigens, by R. S. Metzgar & H. F. Seigler; The distribution of human HL-A antigens in chimpanzees and gorillas, by M. E. Dorf & R. S. Metzgar; Nonhuman primate preclinical antilymphocyte serum testing, by J. J. Smith, C. Darrow, K. W. Sell, G. LaFontaine, & D. E. Kayhoe; Leukocyte antigens of rhesus monkeys and chimpanzees, by H. Balner, H. Dersjant, A. van Leeuwen, W. van Breeswuk, & J. J. van Rood; The baboon as a model for the evaluation of ALS/ALG for use in human patients, by H. D. Brede, G. P. Murphy, H. W. Weber, J. J. W. Van Zyl, & J. N. de Klerk.

Cross-circulation between man simians.--Heterologous cross-circulation for massive hepatic necrosis. A case report, by A. G. May, R. Cestero, R. Satran, R. Crumrine, & M. Turner; The treatment of hepatic coma in man by cross-circulation with baboon, by J. G. Fortner, E. J. Beattie, Jr., M. H. Shiu, W. S. Howland, P. Sherlock, J. Moor-Jankowski, & A. S. Wiener; Cross-circulation between a patient in hepatic coma and a chimpanzee, by H. F. Seigler, J. Patterson, R. S. Metzgar, G. T. Zwiren, R. C. MacDonnell, Jr., B. L. Behrens, & J. J. Corrigan; Exchange transfusion of nonhuman primates with human blood. A program for preparation of cross-circulation partners in hepatic failure, by E. I. Goldsmith, J. Moor-Jankowski, A. S. Wiener, F. H. Allen, & R. Hirsch.

Experimental transplantation in primate animals.--Orthotopic homotransplantation of the liver in baboons, by M. H. Shiu, J. G. Fortner, N. Kawano, Z. Heath, & R. Csurny; Erythropoietin release in baboon renal allografts, by G. P. Murphy, E. A. Mirand, & J. H. Groenewald; Extended preservation of the primate liver by simple cooling and orthotopic autotransplantation,by M. Slapak, M. Chir, M. Baddeley, M. Wexler, C. Saravis, H. Sise, S. Garcia, M. Giouard, & W. V. McDermott; Methods of chemical immunosuppressive treatment in baboon and rhesus monkey allotransplants, by J. H. Groenewald, H. W. Weber, J. N. de Klerk, & G. P. Murphy; Serological studies in kidney allograft rejection in the baboon, by H. D. Brede, G. P. Murphy, & J. J. W. Van Zyl; Human-type erythrocyte A-B-O group and leukocyte antigens of *Papio ursinus*, South Africa, by E. Cohen, Shirley G. Gregory, A. Dozier, J. H. Groenewald, & G. P. Murphy; The effects of biological immunosuppression in baboon kidney allotransplants, by J. H. Groenewald, H. D. Brede, H. W. Weber, & G. P. Murphy; Transplantation immunology in the marmoset, by N. Gengozian, & R. P. Porter;

Experimental allogenic tooth transplantation in primates, by L. B. Shulman.

Comparative biology, genetics and phylogenetics.--Protein structure and primate systematics, by C. J. Jolly; Phylogenetic relationships among primates from immunodiffusion (Ouchterlony) data, by M. Goodman & G. W. Moore; Immunochemical methods in evolutionary studies, by W. Manski; Discussion of Morris Goodman's 'Phylogenetic Relationships among Primates from Immunodiffusion Data', by S. D. Litwin; Blood groups of primates. Their contribution to taxonomy and phylogenetics, by J. Moor-Jankowski & A. S. Wiener; The comparative biology of histaminase and diamine oxidase among New and Old World primates, by J. K. Hampton, Jr., Marian L. Parmelee, & Linda J. Rider; Investigations of nonhuman primate hemoglobin. Fetal hemoglobin, by W. C. Hanly & H. A. Hoffman; Evolutionary relationships of some enzymes, by Ann L. Koen & M. Goodman; Comparative virology of primates, by S. S. Kalter & R. L. Heberling; Cytogenetic studies and observations in the Yerkes Great Ape colony, by H. M. McClure, K. H. Belden, W. A. Pieper, C. B. Jacobson, & D. Picciano; Alkaptonuria in a chimpanzee, by S. P. Watkins, Jr., H. Binley, & N. R. Shulman.

The nervous system. Man and nonhuman primates.--Comparative neuroanatomy of primates, by D. F. Buxton; The evolution of the brain and its importance for physiological research, by H. O. Hofer; Sleep in primates. A review of various results, by J. Bert; Visual similarities of nonhuman and human primates, by F. A. Young & D. N. Farrer; The superior olivary complex in primates, by M. L. Feldman & J. M. Harrison; Endocrine thermoregulatory activity of the hypothalamus, by C. C. Gale.

The nervous system. Perinatal biology and development.--Early somatosensory deprivation as an ontogenetic process in the abnormal development of the brain and behavior, by J. W. Prescott; Motor and behavioral development after neodecortication in the neonatal monkey, by A. Kling & T. Tucker; Brain damage induced by umbilical cord compression at different gestational ages in monkeys, by R. E. Myers; Consequences of asphyxia at birth in the monkey, by A. J. Berman, J. Waizer, & L. Dalton, Jr.; Experimental factors and sexual behavior in male chimpanzees, by W. B. Lemmon.

Behavioral physiology.--Studies of cardiovascular physiology in controlled and unrestrained environments, by O. A. Smith, Jr., D. Reese, G. K. Weiss, F. Spelman, C. Wilson, & E. Snow; Alteration of sleep and circadian rhythms by the use of drugs, by G. V. Pegram, R. J. Bradley, & J. M. Rhodes; Behavioral temperature regulation in the squirrel monkey. Some limits of hypothalamic control, by Eleanor R. Adair.

Reproduction, perinatal and development studies.--

Observations on the ovary of the squirrel monkey, *Saimiri sciureus*, using the light and electron microscope, by A. T. Hertig, N. W. King, Jr., Barbara R. Barton, L. D. Johnson, J. J. Mackey, & C. Bates; The physiological implication of induction of ovulation in the rhesus monkey, by L. S. Wan & H. Balin; The analysis of male fertility, artificial insemination and natural matings in the laboratory breeding of macaques, by D. A. Valerio, W. E. Leverage, J. C. Bensenhaver, & H. D. Thornett; Reproductive physiology and pregnancy in marmosets, by J. K. Hampton, Jr., S. H. Hampton, & B. M. Levy; The electron microscopy of the placental villi in nonhuman primates *Galago demidovii*, *Erythrocebus patas*, *Macaca fascicularis*, *Macaca mulatta* and *Papio cynocephalus*, by M. Panigel; Comparative aspects of chorionic gonadotrophin production in nonhuman primates, by W. W. Tullner & R. Hertz; Metabolism of progesterone in the fetus and placenta of the rhesus monkey (*Macaca mulatta*), by S. Solomon & K. Leung; Metabolism of pregnenolone and dehydroisoandrosterone injected into the umbilical vein of the pregnant baboon (*Papio cynocephalus*), by I. Merkatz, K. Leung, F. Fuchs, & S. Solomon; The placental transfer of polypeptide hormones related to carbohydrate metabolism, by R. A. Chez, D. H. Mintz, E. O. Horger III, & D. L. Hutchinson; Regional circulation in the fetal and neonatal primate, by R. Behrman & C. W. de Lannoy; Fetal biology of the rhesus monkey (*Macaca mulatta*), by G. R. Kerr & H. A. Waisman; Maternal hyperaminoacidemia and its effect on the developing rhesus monkey fetus, by H. A. Waisman & G. R. Kerr; Further observations on the development of the baboon (*Papio sp.*) by A. J. Hendrickx; The influence of ethanol infusion on the course of spontaneous and induced labor, by R. A. Baratz, H. O. Morishima, T. Horiguchi, L. S. James, & K. Adamsons; Anesthesia for hysterotomy in the subhuman primate, by H. O. Morishima & A. I. Hyman; The effect of halothane-induced maternal hypotension in the fetus, by A. W. Brann, Jr., R. E. Myers, & R. DiGiacomo.

Virology.--Introduction to Virology Chapter, by S. S. Kalter; Recent developments in nonhuman primate virology. A review, by R. L. Heberling & S. S. Kalter; Simian hemorrhagic fever, by N. M. Tauraso, S. S. Kalter, Joan J. Ratner, & R. L. Heberling; Viral oncogenesis in nonhuman primates, by L. G. Wolfe, Barbara Marczynska, H. Rabin, R. Smith, P. Tischendorf, Frances Gavitt, & F. Deinhardt; Rabies in primates, by R. N. Fiennes; Herpesviruses from South American monkeys, by L. V. Melendez & M. D. Daniel; A pox disease of monkeys transmissible to man, by C. Espana; A comparative study of cytomegaloviruses of primates and nonprimates, by G. D. Hsiung, N. S. Swack, M. Gharpure, & K. Tscholl; Comparison of viral infection in chimpanzees recently imported and in a closed colony, by K. F. Soike, J. D. Douglas, & F. Coulston; Hepatitis associated antigen. Long term persistence in chimpanzees, by A. Prince.

Infectious diseases.--Spontaneous melioidosis in recently imported monkeys, by J. D. Douglas, R. J. Cronin, & A. F. Kaufmann; Experimental streptococcal infections in nonhuman primates, by A. Taranta, G. Goldstein, M. Spagnuolo, M. Davidson, & J. W. Uhr; Humoral aspects of treponematoses of chimpanzees, by U. S. G. Kuhn III; Physiopathology of endotoxemia. Primate animal as a prospective subject for study, by F. K. Beller; Primates as models for parasitological research, by T. C. Orihel; Experimental trachoma in owl monkeys and Taiwan monkeys, by C. E. O. Fraser & S. D. Bell; Mycoplasm investigation in macaques. Isolation of an unidentified strain, by M. Sepetjian & M. Bonneau.

Reports from major primate laboratories and current programs.-- Care and management of a Great Ape colony, by Michaele E. Keeling & N. B. Guilloud; Visiting Scientists Program Southwest Foundation for Research and Education, by R. L. Hummer; Regional Primate Research Center at the University of Washington. Unique features and research themes, by T. C. Ruch; Studies of primate diseases at the Delta Center, by A. J. Riopelle, J. P. Ayres, H. R. Seibold, & R. H. Wolf; Characterization of the research program of the New England Regional Primate Research Center, by B. F. Trum; Primates in pesticide research, by G. Morrison; Primates in eye movement research, by A. M. Schrier, M. L. Povar, & J. Vaughan; Primates in dental research, by B. M. Levy, S. Dreizen, J. K. Hampton, Jr., A. C. Taylor, & Suzanne K. Hampton; The dental polymer implant in the baboon, by M. L. Povar, M. Hodosh, & G. Shklar; Studies on atherosclerosis of some nonhuman primates, by N. D. M. Lehner, T. B. Clarkson, B. C. Bullock, H. B. Lofland, R. W. St. Clair, & R. W. Prichard; A primate program developed for the testing of biological products, by Ruth L. Kirschstein & A. E. Palmer; A program for inoculation of primates with potentially oncogenic viruses, by R. Kinard; The care of baboons used in human leukemia and oncogenic virus studies, by W. R. Voss; Maintenance of juvenile simians for ocogenic studies, by S. Sibinovic, D. A. Valerio, J. C. Landon, & S. Leiseca; Use of marmosets in biomedical research, by F. Deinhardt; Male and female cell populations in the chimeric marmoset, by N. Gengozian; The Laboratory for Experimental Medicine and Surgery in Primates. Background and policy, by J. Moor-Jankowski & E. I. Goldsmith; Laboratory for Experimental Medicine and Surgery in Primates (LEMSIP). Design and operation, by J. H. Davis & J. Moor-Jankowski; Primatology Centre, by B. Chiarelli; Architectural conception and building design of the French Primate Center, by G. Mahouy, J. C. Friedmann, & R. Mendelsson; Primate studies in Britain, with a note on the functional anatomy of the vena cava in relation to hypotensive states, by R. N. Fiennes; Report on the activities of the University of Stellenbosch primate colony, by J. J. W. van Zyl; The Primate Information Center, by Maryeva W.

Terry; Teaching program in medical primatology for medical students, by Elizabeth Muchmore, J. L. Potter, J. Moor-Jankowski, & E. I. Goldsmith; The logistics of the supply of primate animals for medical research, by M. A. Nolan.

Comparative genetics in monkeys, apes and man. Chiarelli, A. B. (Ed.) New York/London: Academic Press, 1971. [Price: $16.50]

This is the proceedings of a symposium on Comparative Genetics in Primates and Human Heredity held at Ernice, Sicily, July, 1970.

Contents: Introduction, by A. B. Chiarelli; Comparative primate genetics and human heredity, by H. Kalmus; Epigenetic polymorphism in the primate skeleton, by A. C. Berry & R. J. Berry; The heredity of dermatoglyphic traits in non-human primates and man, by J. Mavalwala; Phenylthiourea testing in primates, by H. Kalmus; Blood groups of non-human primates and their relationship to the blood groups of man, by A. S. Wiener & J. Moor-Jankowski; Leukocyte groups of non-human primates; their relation to histocompatibility and to human HL-A antigens, by H. Balner, B. W. Gabb, H. Dersjant, W. v. Vreeswijk, A. v. Leeuwen & J. J. v. Rood; Genetic structure and systematics of some macaques and men, by M. L. Weiss & M. Goodman; Evolving primate genes and proteins, by M. Goodman, A. L. Koen, J. Barnabas, & G. W. Moore; Comparison of the hemoglobins in non-human primates and their importance in the study of human hemoglobins, by B. Sullivan; Phylogenesis of immunoglobulins in primates, by A. O. Carbonara; Comparative cytogenetics in primates and its relevance for human cytogenetics, by A. B. Chiarelli; Concluding remarks, by N. A. Barnicot.

Primate societies. Group techniques of ecological adaptation. Kummer, H. Chicago: Aldine-Atherton, 1971.

BIBLIOGRAPHIES

The baboon: An annotated bibliography. Supplement IV. San Antonio, Texas: Southwest Foundation for Research and Education, 1971.

The original bibliography was published in 1964 by The Baboon Information Center of Southwest Foundation for Research and Education. This volume contains 1,589 abstracted references dating back to 1607. Supplements to the original volume were published in 1965, 1967, and 1969. The total number of references cited, including those in this, the fourth supplement, now stand at 3,612.

The original articles from which the abstracts have been prepared are on file at the Foundation and are available for single copy reproduction. On request, a Xerox copy will be prepared at a cost of 10 cents per page, (one

dollar minimum charge), which rate includes mailing costs. To obtain this service, please contact Mrs. Dorothy M. Brooks, Librarian, Baboon Information Center, Southwest Foundation for Research and Education, P.O. Box 28147, San Antonio, Texas 78284.

Laboratory animals: An annotated bibliography of informational resources. Cass, J. S. (Ed.) New York: Hafner, 1971 [Price: $14.95]

This publication brings together under one cover 3 "Compilations." The first was published in the *Federation Proceedings* in 1960 (*19* [No. 4, Supplement 6]) and consists of 1,528 references. The second was published in the *Federation Proceedings* in 1963 (*22* [No. 2, Supplement 13]) and consists of 1,592 references. The third compilation, previously unpublished, was completed during 1971 and contains 460 references, some of which were included in the earlier Compilations.

The first two compilations are organized under the following headings: Normal anatomy, physiology, psychology; Diseases, abnormalities, injuries, including diagnostic tests, prevention; Nutrition: food and water requirements, diets, dietary supplements or additives; Breeding programs: design and operation of production colony; Design and operation of maintenance and use colony; Procurement and use of animals; Special techniques, preparation of animals for use, handling, anesthesia, euthanasia; Administration of colonies: records, costs, personnel, public relations; Periodical and other publications of general interest. The third compilation is organized under the following headings: Taxonomy; Anatomy, embryology, physiology; Behavior, animal psychology; Natural environment, effects, adaptation; Medicine, pathology, pharmacology; Nutrition, feeding; Breeding, reproduction, genetics; Husbandry, management, housing; Procurement, sources, regulations; Animal models; Techniques (experimentation, surgery, anesthesia, etc.); Bibliographies, periodicals, biologic standards.

DISEASE

Virtual absence of infection with *Herpesvirus simiae* in colony-reared rhesus monkeys (*Macaca mulatta*), with a literature review on antibody prevalence in natural and laboratory rhesus populations. DiGiacomo, R. F., & Shah, K. V. (Lab. Slow, Latent & Temperate Virus Infections, Nat. Inst. Neurol. Dis. & Stroke, NIH, Bethesda, Md. 20014) *Laboratory Animal Science*, 1972, *22*, 61-67.

A serologic survey of 39 laboratory-reared rhesus monkeys (*Macaca mulatta*) ranging in age from 1-7 years revealed the presence of neutralizing antibody to *Herpesvirus simiae* (B-virus) in only 1 monkey, an adult breeding female.

These monkeys were housed for a number of years among rhesus monkeys obtained from India, many of which had B-virus antibodies. The practice of individual caging or the absence of infectious individuals are probably the factors responsible for this extremely low antibody prevalence. It was concluded that laboratory rearing of rhesus monkeys can exclude infection with *Herpesvirus simiae* and that there is virtually no spread of B-virus infection to individually caged monkeys in a well-established colony. Certain epidemiological features of this infection were delineated from a review of the literature on B-virus antibody surveys.

An epizootic of tuberculosis in a municipal zoo: a public health problem. Frederickson, L. E., Barton, C. E., Ragan, J. R., & Roberts, J. W. (Tennessee Dept. Public Health, Nashville, Tenn. 37219) *Journal of the American Veterinary Medical Association*, 1971, *159*, 1474-1476.

Mycobacterium tuberculosis was isolated from a dead rhesus nursing female in a municipal zoo housing 23 non-human primates. Included in the colony were ringtail, squirrel monkeys, and baboons, in addition to rhesus. Tuberculin testing of the rest of these animals, prior to depopulation, did not reveal any discernable response. However, when necropsied, 3 rhesus, 2 baboons, and 1 ringtail had lesions compatible with T.B., and *Mycobacterium tuberculosis* was isolated from them. The primary case was the newest member of the colony obtained 2 months prior to its death. Diseased animals on public display are an obvious health hazard and greater public and governmental awareness is advocated.

Psorergatic mites in patas monkeys. Raulston, G. L. (Publications Branch, US NAMRU 2, Box 14, APO San Francisco) *Laboratory Animal Science*, 1972, *22*, 107-108.

Psorergatic mites were found in a previously unreported host, *Erythrocebus patas* monkeys, in scrapings from periorbital and chest lesions. The lesions regressed after treatments with chlordane.

Cutaneous horn in a rhesus monkey. Brown, R. J., Britz, W. E., Kupper, J. L., & Trevethan, W. P. (Naval Aerospace Med. Inst., Naval Aerospace Med. Cen., Pensacola, Florida 32512) *Laboratory Animal Science*, 1972, *22*, 112-113.

A cutaneous horn on the head of a rhesus monkey was reported. The horn resembled a tooth and was removed surgically. There was no recurrence during a 6-month follow-up period. No other cutaneous horns have been observed in the rhesus monkey colony of 65 animals.

Persistent pupillary membrane: developmental review and an occurrence in *Macaca mulatta*. Kirk, J. H. (Radiobiology Div.,

USAF Sch. Aerospace Med., Aerospace Med. Div., AFSC, Brooks Air Force Base, Texas 78235) *Laboratory Animal Science*, 1972, *22*, 122-125.

Persistent pupillary membranes are remnants of the pupillary membrane which nourished the lens during fetal life. The membranes, which are composed of vessels and mesodermal tissue, usually disappear before birth in humans. The persistent membranes arise from the anterior iris surface and attach to the anterior lens capsule. The reported case occurred in a 4-year-old *Macaca mulatta* being utilized in a low energy proton irradiation study. The membrane arose from several sites on the anterior surface of the iris and attached to a common site on the anterior capsule of the lens. Although persistent pupillary membranes have occurred frequently in infant humans, their incidence in *M. mulatta* has not been clearly determined.

Outbreak of malignant lymphoma in rhesus monkeys. Stowell, R. E., Smith, E. K., España, C., & Nelson, V. G. (Nat. Cen. Primate Biol., U. California, Davis, Calif. 95616) *Laboratory Investigation*, 1971, *25*, 476-479.

These initial 24 cases of an outbreak of malignant lymphoma occurred during an interval of 25 months at the National Center for Primate Biology. The incidence of lymphoma was disproportionately high in adult female *Macaca mulatta* with widespread, diverse organ involvement. Inoculation of tumor cells into one immunosuppressed neonate rhesus resulted in widespread tumor growth in 3 months at sites other than those of inoculation. Preliminary studies of pathogenesis indicate the need for further evaluation of several viral isolates, epidemiologic studies of proximity of affected animals, the potential role in some of the animals of repeated exposure to roentgen radiation, and/or prior infection with malarial parasites. A number of the features of this lymphoma resemble Burkitt's tumor.

PHYSIOLOGY AND BEHAVIOR

Observations on copulation and seasonal reproduction of two species of spider monkeys, *Ateles belzebuth* and *A. geoffroyi*. Klein, L. L. (Dept. Anthropology, U. Illinois, Urbana-Champaign, Ill. 61801) *Folia Primatologica*, 1971, *15*, 233-248.

Observations on the sexual behavior of 2 species of spider monkeys, *Ateles belzebuth* and *A. geoffroyi* indicate that primary sexual behavior is diurnal and, in contrast to groups of *Saimiri sciureus* sympatric with *A. belzebuth* at a South American study site, nonseasonal. The copulatory posture taken by the male spider monkey during penile insertion is different from that described for any other primate. Behavioral data strongly support the hypothesis that the transmission of information concerning female

sexual receptivity is via chemical stimuli, and that the primary function of the female spider monkey's hypertrophied clitoris is the deposition of urinary scents.

Colobus guereza: birth and infant development in captivity. Wooldridge, Frances L. (Dept. Zoology, U. South Florida, Tampa, Fla.) *Animal Behaviour*, 1971, *19*, 481-485.

Labor postures performed during birth of *Colobus guereza* are a series of alternating torso stretches. Early development of this species differs from many Old World monkeys in that females other than the mother are allowed to handle the very young infant and males show considerable interest in infants.

Répertoire comportemental du talapoin (*Miopithecus talapoin*). [Behavioral repertoire of the talapoin monkeys.] Gautier-Hion, A. (Laboratoire de Primatologie et d'Ecologie équatoriale, B.P. 18--Makokou--Gabon) *Biologia Gabonica* 1971, *7*, 295-391.

This behavioral repertoire includes non-social and social behavior. In its agonistic behavior, the talapoin monkey shows two peculiarities: (1) chorus and (2) mobbing behavior. It appears that agonistic and sexual behavior of this species are different from those of other *Cercopithecus spp*. According to behavioral characteristics, the talapoin monkey must be considered as a distinct genus from the genus *Cercopithecus*.

Are apes capable of language? Ploog, D., & Melnechuk, T. (Max Planck Institute for Psychiatry, Munich, West Germany) *Neurosciences Research Program Bulletin*, 1971, *9*, 600-700.

This bulletin summarizes a one-day conference, including background material and second thoughts of the participants, that grew out of an earlier longer Work Session on "Primate Communication" (Ploog & Melnechuk, 1969) where the work of Gardner and Gardner and Premack was mentioned. In these experiments humans taught themselves linguistic systems in which a chimpanzee could participate. The subject was pursued in greater detail at the conference with which the present report deals. The participants were Julian H. Bigelow, Roger W. Brown, Jerome S. Bruner, Irven DeVore, Merrill F. Garrett, Richard Hirsh, Erich H. Lenneberg, Theodore Melnechuk, Detlev Ploog, David Premack, Francis O. Schmitt, Howard H. Wang, & Frederick G. Worden.

ANATOMY

Sequence of eruption of permanent teeth and epiphyseal union in New World monkeys. Tappen, N. C., & Severson, A. (Dept. Anthropology, U. Wisconsin, Milwaukee, Wis. 53201) *Folia Primatologica*, 1971, *15*, 293-312.

Sequences of eruption of teeth and union of epiphyses are given for local populations of 3 species of monkeys from South America. These sequences are highly scalable for each species and are very similar among the different species. Tentative chronological ages of epiphyseal union can be assigned to younger individuals in 2 species by utilizing chronological ages of dental eruption published by other investigators. The sequences of epiphyseal union in these New World monkeys are very similar to published sequences in Old World monkeys. No specimen in the present series was completely mature skeletally.

INSTRUMENTS AND TECHNIQUES

Videotape as a replacement for the human observer in studies of nonhuman primate behavior. Candland, D. K., Dresdale, L., Leiphart, J., & Johnson, C. (Bucknell U., Lewisburg, Pa. 17837) *Behavior Research Methods and Instrumentation*, 1972, *4*, 24-26.

For both field and laboratory studies of animal behavior, the availability of portable videotape recorders permits both improved techniques of observation and a means for permanent storage and rapid retrieval of observations. In some circumstances, videotape may be used to replace a human observer. Evidence is presented that the behavior of at least one nonhuman primate commonly used in behavioral research, the squirrel monkey, differs when a human observer is present from when behavior is recorded solely by videotape, even after 3 years of daily contact with human beings.

Kleinstsender für die Übertragung von Affenlauten. [Miniature transmitter for broadcasting the vocalizations of monkeys.] Maurus, M., & Szabolcs, J. (Max-Planck-Institut für Psychiatrie, Abteilung für Verhaltenforschung, München, Germany) *Die Naturwissenschaften*, 1971, *5*, 273-274.

A battery-operated miniature broadcasting device for mounting on the heads of monkeys is described. It transmits the monkeys' vocalizations, which are received as visual signals, over individual frequencies. This permits the monitoring of vocalizations of each member of a group of monkeys.

A heat-trap shelter for rhesus monkeys (*Macaca mulatta*) housed outdoors. Smith, A. W., Johnson, D. K., & Simmonds, R. C. (Research Animal Division, Naval Biomedical Res. Lab., NSC, Oakland, California 94625) *Laboratory Animal Science*, 1972, *22*, 90-92.

Simple and inexpensive shelters were tested in an outside colony of breeding age rhesus monkeys (*Macaca mulatta*). The shelters were constructed with insulating material refractory to the destructive actions of the animals. The

shelters were rectangular boxes with an open underside for entrance; they contained perches and a transparent front. No moving parts nor electrical power were required. The shelters trapped body heat and afforded protection against moisture and wind. These shelters were highly successful as judged by their economical design, frequency of use, cleanliness, ease of maintenance, and positive temperature differential relative to external ambient temperatures.

Two discrimination test apparatuses for primates. Rumbaugh, D. M., Bell, C. L., & Gill, T. V. (Yerkes Reg. Primate Res. Cen., Atlanta, Ga. 30322) *Behavior Research Methods and Instrumentation*, 1972, *4*, 6-10.

This paper describes two test apparatuses developed to facilitate discrimination learning studies with primates. The semi-automated apparatus provides for presentation of stereometric stimulus materials through the illumination of lamps which make a one-way mirror transparent at the onset of a trial. The totally automated test system was developed to facilitate the collection of Transfer Index (TI) measurements, measurements intended to provide for equitable assessments of the learning-set capabilities of diverse primate genera. The TI test procedures and the system's operations provide for criterional mastery (67% or 84% responses correct) of two-choice visual discrimination problems, consisting of projected patterns, then reversal of cues for the 10 test trials that are of particular significance in calculation of the TI scores.

A simple primate headholder. Nelson, K. M., & Hasenpusch, P. H. (Dept. Neurosurgical Surgery, Roswell Park Memorial Inst., N. Y. State Dept. Health, Buffalo, N. Y. 14203) *Journal of Surgical Oncology*, 1971, *3*, 475-476.

Headholders for primate surgery have tended to be expensive, requiring either custom machining or portions of stereotaxic equipment to provide stable fixation of the skull. Since a headholder is fundamentally a vise, the modification of a standard pan head ball joint vise has produced an inexpensive headholder providing adequate exposure of the skull, leaving the structures above the inferior orbital rim unobstructed, and reducing equipment cost.

New liquid-diet feeder for primates. Walike, Barbara C., Campbell, D. J., & Hillmann, R. A. (Reg. Primate Res. Cen. & Dept. Physiol. & Biophysics, U. Washington, Seattle, Wash. 98195) *Journal of Applied Physiology*, 1971, *31*, 946-947.

A liquid-diet feeding system for use with primates is described. This system permits the accurate measurement and recording of timing, rate, and amount ingested by a monkey. The mouthpiece can be mounted at some distance from the liquid diet reservoir and pump, thereby facilitating its use in metabolic and behavioral studies requiring enclosure of the subject in a calorimeter or soundproof booth. The device is equally useful for delivery of liquid diets, diluted applesauce, juice, water, and other fluids.

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