

Plasma cortisol of female rhesus monkeys
in response to acute restraint.

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Plasma Cortisol of Female Rhesus Monkeys in Response to Acute

Restraint

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Introduction

Primates kept in laboratory colonies experience a variety of handling and manipulative procedures in conjunction with health, breeding, or experimental protocols. Examples range from blood sampling, weighing, injections, and palpations to more invasive procedures such as C-sections. All of these necessitate some degree of restraint (manual or chemical) or confinement (such as in a transfer box) of the animal. To the extent that the restraint procedures themselves are stressful (albeit often unavoidably), they have implications for the well-being of laboratory primates, an issue which has become the subject of wide concern.

Previous studies have investigated the response of laboratory primates to several forms of restraint. The majority of these have noted behavioral and physiologic responses indicative of moderate to severe psychologic stress in response to handling and manual restraint (Mason, Harcourt, & Rosenthal, 1957), tethering (Kaplan, Adams, & Bumsted, 1983), chair restraint (Kling & Orbach, 1963; Mason, Harcourt, & Rosenthal, 1957), surgery board restraint (Clarke, Mason, & Moberg, 1987), and anesthesia (Wall, Worthman, & Else, 1985; Elvidge et al, 1976). Habituation to some procedures may occur only slowly (Burton, Burns, & Smith, 1981; Coe, et al, 1983; Kaplan, Adams, & Bumsted, 1983).

Less severe manipulations may also result in measurable stress responses, even in experienced animals. Movement to a novel cage may cause behavioral and physiologic stress responses (Coe, et al, 1983; Hennessy, Mendoza, & Kaplan, 1982; Mitchell & Gomber, 1976; Nash & Chilton, 1986), as may confinement in a transfer box for only a brief period (Clarke, 1987). At least some habituation occurs to these procedures after repeated exposure (Clarke, 1987; Coe, et al, 1983).

This investigation compared plasma cortisol responses of female rhesus monkeys (*Macaca mulatta*) to short periods of manual restraint in the home cage with those obtained after short periods of confinement in a transfer box. These procedures are commonly used in primate colonies for blood-sampling (manual restraint) and management procedures (transport).

Methods

The subjects were 10 adult female rhesus macaques (age range 5-11 yrs). They were all colony-born in large outdoor multimale, multifemale groups. They had lived outdoors for at least 25 months and had been housed indoors in single cages for at least 15 months. They were housed in two rooms with approximately 50

other rhesus monkeys for five months prior to the study. The animal rooms were illuminated for 12 hours daily, and cleaned daily at 0900-1000 hours. They were fed commercial monkey chow at 0800-0900 and 1400-1500 hours. The monkeys were being used for an environmental enrichment experiment which evaluated their behavioral and physiologic responses to a cage enrichment apparatus (a device which delivered food and music). They were assigned to experimental (apparatus present) and control (no apparatus) groups of 5 monkeys each. During this time the monkeys had experienced brief manual restraint for venipuncture at two week intervals. The monkeys had experienced brief transfer box confinement approximately 4-5 times a year during the time they were housed indoors.

Tests of the monkeys' plasma cortisol responses to restraint in the home cage and confinement in a transfer box were performed at two week intervals. Each monkey was tested twice in the home cage (tests 1 and 2) and then twice in the transfer box (tests 3 and 4). All tests were performed between 1300 and 1600 hours. Pre-test blood samples were collected within three minutes of entering the animal room in all tests. Venipuncture was accomplished by restraining the monkey using the cage squeeze mechanism and withdrawing the arm through the partially open cage door. For the home cage test the monkey was then held in this position for 15 minutes, after which a post-test blood sample was taken. For the transfer box test the subject was placed for five minutes in a transfer box that remained attached to the front of the cage. The monkey was then returned to its cage and the experimenters left the room. They returned 15 minutes later and collected a post-test blood sample, again within three minutes of entering the room. Thus, for both conditions, post-test sample results reflect not only the response to restraint, but also to the pre-test venipuncture.

All blood samples were collected into syringes containing Na EDTA. Samples were placed on ice and centrifuged at 4deg C within 20 minutes of collection. Plasma was removed and stored at -70deg C until assayed for cortisol via radioimmunoassay. The intraassay coefficient of variation was 4.3%.

The mean plasma cortisol levels of the experimental and control groups were compared by a Student's t-test. None of the differences between means were significant, thus the data for both groups were combined for subsequent analysis. Pre- and post-test cortisol levels were then compared with a 2-way analysis of variance for each condition.

Results

There was a nonsignificant ($p = .21$) increase in mean plasma cortisol levels in response to venipuncture and restraint in the home cage (*Figure 1*). Some of the monkeys struggled briefly during the restraint, but most sat calmly throughout the 15 minute period. In contrast, the mean increase in cortisol in response to venipuncture and confinement in a transfer box was highly significant ($p = .003$). Several monkeys urinated or defecated in the transfer box, or displayed

submissive postures toward the experimenters. The mean cortisol levels for both the pre- and post-test samples were lower in test 4 than in test 3 ($p = .0243$), but the magnitude of the increase in cortisol between samples was similar in both tests.

Figure 1: Mean (+/-SE) plasma cortisol levels of 10 female rhesus macaques before and after 15 minutes of restraint in the home cage (tests 1 and 2) and 5 minutes of confinement in a transfer box (tests 3 and 4).

Discussion

The lack of an increase in cortisol in response to restraint in the home cage was an unexpected finding. Physical immobilization has often been found to cause a significant physiologic response in experimental animals. While the monkeys in this experiment had never been restrained for 15 minutes prior to the first home cage restraint test, they had been restrained for three minutes for blood sampling at two week intervals 10 times before the experiment. Thus they were familiar with the experimenters and the blood sampling process, and the only new component in tests 1 and 2 was the duration of restraint. The results indicate that the increase in the duration of restraint was not a significant event to the monkeys.

Confinement in a transfer box was a significant event, as measured by cortisol response, even though this condition was presumably intrinsically less stressful than manual restraint. Transfer box confinement represents a reduction in space from the home cage and thus some restriction in movement, but to a much lesser degree than the near-complete immobilization accomplished by use of the cage squeeze mechanism. Moreover, duration of confinement was less than for home cage restraint (five vs fifteen minutes). Both duration and degree of restraint have been correlated with magnitude of cortisol response in macaques (Clarke, Mason, & Moberg, 1987). All of the monkeys had been in transfer boxes before, but not for 6 months prior to tests 3 and 4. While it presumably caused no physical discomfort, box confinement presented a change from the normal routine. The pronounced cortisol response to box confinement but not to home cage restraint suggests that the salient difference between the two conditions for the monkeys was a difference in the relative novelty of the two situations. However, placement in a transfer box is often a prelude to other stressful events such as movement to a new cage or experimental procedures, and association with such events may also have contributed to the monkeys' responses.

There was no clear evidence of habituation of the monkeys' response to the transfer box. The pre- and post-test cortisol levels were lower in test 4 than test 3, but the magnitude of the increase was approximately the same in both tests. The lower pre-test level in test 4 probably reflected normal day-to-day variation in baseline secretion of cortisol.

Finally, it should be noted that venipuncture itself did not elicit a significant cortisol response, even though such a response has been reported in other studies (Riley, 1981). In fact, the reported rapidity of this response is the basis for the common practice of obtaining blood samples within a brief and predetermined time period in studies of plasma cortisol responses to stimuli. Apparently the monkeys had habituated to the venipuncture procedure, such that this event, even with added restraint duration, did not elicit the predicted substantial cortisol response.

The results of this experiment suggest that routine events, even ones like venipuncture and restraint that involve mild physical discomfort and psychologic stress, do not cause a significant physiologic response in habituated rhesus monkeys. In contrast, other events which cause no physical discomfort may lead to a significant physiologic response if they are not part of the normal routine, even if the monkeys are familiar with the procedure. These findings agree with those from previous studies (Hennessy, Mendoza, & Kaplan, 1982; Mitchell & Gomber, 1976; Nash & Chilton, 1986; Phoenix & Chambers, 1984) indicating that novelty alone can be a significant source of stress for laboratory primates.

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Chimpanzee Committee Formed

The newly formed Committee for Conservation and Care of Chimpanzees (CCCC) was conceived as a loose international coalition of scientists and other professionals who conduct noninvasive research with chimpanzees and who are dedicated to their protection in the wild and to the improvement of their living conditions in captivity. At an international symposium devoted to "Understanding Chimpanzees" held on November 7 to 11, 1986, which was sponsored by the Chicago Academy of Sciences, some 30 experts expressed an

interest in permanent membership. The expected total membership after a year of expansion will be about 50-60 professionals. The CCCC operates under the sponsorship of the Jane Goodall Institute for Wildlife Research, Education and Conservation, which in turn is administered by the William M. Clements Foundation.

The CCCC's most important role will be to formulate, produce, and disseminate substantive guidelines for better protection and superior care of chimpanzees. Other functions include the establishment of an information resource base on chimpanzee research, and of a special fund to survey remnant populations in Africa. Additional long-range goals remain to be defined when membership has been expanded.

Dr. Geza Teleki, who has been professionally involved with chimpanzee conservation and care issues for many years, will serve as ad hoc Chairman for a formative period of at least two years, in a full-time post devoted to organizing an international membership, establishing productive long-range objectives, and initiating formal action on priority tasks identified at the symposium. Correspondence concerning the CCCC may be sent to Dr Teleki at 3819 48th Street, NW, Washington, DC 20016 [Telephone: 202-362-1993].

* * *

Environmental Enrichment with Sticks for Singly-Caged Adult Rhesus Monkeys

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University of Wisconsin

Introduction

Legislation will soon make it imperative that individuals working with captive nonhuman primates devise methods of environmental enrichment for their research subjects. The primary rationale of these new regulations will be to enhance the psychological well-being of the captive primates. Research paradigms have been utilized both in research laboratories and zoos to examine various enrichment methodologies. These studies strongly suggest that environmental enrichment has beneficial effects on the behavior of captive primates.

Numerous studies have examined the effects of environmental enrichment on the behavior of group-housed primates. Enrichment decreases the frequencies both of self-directed and stereotypy maladaptive behavior patterns (Pfeiffer & Koebner, 1978; Clarke et al., 1982; Bloomstrand et al., 1987), and reduces aggression (Chamove et al., 1982; Maple & Stine, 1982). A particularly robust effect following environmental enrichment is increased motor activity and object manipulation (Pfeiffer & Koebner, 1978; White, 1978; Chamove et al., 1982; Clarke et al., 1982;

Maple & Stine, 1982; Wilson, 1982; Tripp, 1985; Westergaard & Fragaszy, 1985). Environmental enrichment has also been found to decrease fearful or distressed behavior in novel environments (Champoux et al., 1987).

Relatively little research has focused on the problem of environmental enrichment for singly-caged animals. The addition of social partners has been utilized as an enrichment technique with success (e.g. Reinhardt et al., 1987a) but this method is not feasible in research paradigms stipulating individual housing of animals. Attempts at enrichment utilizing inanimate objects generally involve relatively expensive devices such as electrical or mechanical manipulanda which produce response-contingent feedback, food puzzles, television sets, and radios (Spinelli & Markowitz, 1985; Line, 1987; Clarke et al., 1987), though Renquist & Judge (1985) used nylon balls as an enrichment technique. Reinhardt and co-workers (1987b) found that simply providing singly-caged rhesus macaques with a deciduous tree branch proved equally effective in enriching the animals' barren environment.

In this study the cages of singly-housed adult rhesus macaques were enriched by the addition of small sticks from deciduous trees. Sticks were chosen because they are inexpensive, readily obtainable, easy to clean, and, unlike branches, are usable in squeeze cages as well as in standard cages.

Methods

Subjects were 48 randomly selected singly-caged adult rhesus macaques (*Macaca mulatta*). There were 28 females, 13 males, and 7 pseudohermaphrodite females ranging in age from 6 to 30 years. Individuals were housed in 70 x 75 x 77 cm stainless steel cages in rooms maintained on a 12:12 light cycle. The animals were fed Purina Monkey Chow between 0700 and 0800; water was available ad lib. All animals were checked daily for health assessment.

Each animal was provided with a stick for a 12-week period. For the first two weeks of the study, sticks were cut from felled box elder trees (*Acer negundo*). The sticks were 19 cm long and had a mean radius of 2.5 cm, and a mean volume of 370 cc. In the third week of the study, the box elder sticks were replaced with thick black cherry sticks (*Prunus serotina*). The substitution was made because the soft box elder wood produced long thick splinters when gnawed by the monkeys; these frequently clogged drains. The situation was alleviated with the hard black cherry wood. The black cherry sticks were also 19 cm long, but they had a mean radius of 4.5 cm and a mean volume of 1200 cc. A black cherry stick was replaced whenever it was worn to half its original volume. To assess use of the sticks, their volumes were measured every two weeks. A stick was considered to have been used if either of the two following criteria were met:

1) if the reduction in the volume of the stick was greater than 2% every two weeks, or:

2) if the reduction in the volume of the stick was less than 2%, but the animal was observed or heard rolling the stick over the floor at least twice every two weeks.

Behavioral observations were conducted on 13 laboratory-born monkeys ranging in age from 5 to 25 years. They were initially habituated to the presence of one observer (the senior author) during a two-week period. Eight baseline behavioral observations were conducted after this familiarization period over a 3-week block prior to enrichment. Five further observations were carried out during the initial 10 days following the introduction of the stick. All observations were conducted between 1530 and 1630 on weekdays. Only the initial behavior(s) exhibited by the animals was recorded.

For the purposes of analysis, the observed behaviors were combined into the following categories: sitting posture; standing or crouching posture; activity (environmental exploration, locomotion, or eating); self-directed; and hostility to observer. The percent of observations in which the animal was observed engaging in each behavior category was calculated for both the preenrichment and postenrichment phases. Pre- and postenrichment data were compared utilizing a one-way analysis of variance.

Results

The animals used their sticks in 65% (31/48) of cases; of the animals that used their sticks, 84% (26/31) used them continually throughout the 12 weeks, whereas 16% (5/31) stopped using them after 2 to 6 weeks. Gnawing accounted for 90% (28/31) of stick usage, rolling for only 10% (3/31). Figure 1 depicts two typical examples of the patterns of stick use during the 12 week study period.

Figure 1: Example of two-singly caged adult rhesus monkeys who continually used their sticks for gnawing throughout the 12-week study.

When all animals are entered into the analysis regardless of use of stick, the cage enrichment had a significant effect on self-directed behavior ($F(1,13) = 8.43, p = .01$). Self-directed behavior was observed in 23.5 percent of scoring sessions prior to enrichment, versus 11.4 percent postenrichment. Prior to enrichment, the animals could be divided into those which exhibited activity and those which did not. Enrichment had the effect of increasing the level of activity of the second category of animals only, from 0 percent to 22.9 percent. The activity rates of the first category of animals remained relatively constant at 17.3 percent preenrichment and 17.5 percent postenrichment. Other behavior categories were not significantly affected by the introduction of the stick.

Discussion

Addition of sticks to the home cages of singly-housed adult rhesus macaques was found to be an effective and inexpensive method of environmental enrichment. The sticks were utilized by the majority of the subject population, with only 16%

of them gradually losing interest over the twelve-week test period. Enrichment decreased the frequency of self-directed behavior, but increased the activity levels of those animals which had previously been inactive. These results concur with previous studies of enrichment on group-housed animals (Pfeiffer & Koebner, 1978; Clarke et al., 1982; Bloomstrand et al., 1987), and suggest that the well-being of singly-caged animals may be enhanced in many instances by a relatively simple environmental manipulation.

It is undeniable that environmental enrichment for singly-caged primates is vitally important, as these animals are generally denied the social stimulation allowed to group-housed animals. Because the research protocol of many laboratories will continue to call for singly-caged animals, it is essential that more paradigms be developed that test potential forms of enrichment.

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News Briefs

Smith Introduces Legislation to Send IBR Research Animals to Primarily Primates

As promised at a June 25 rally held on the Capitol steps, Rep. Robert C. Smith (R-NH) has introduced H.R. 2883, a bill "to provide for the transfer of certain

monkeys to the animal sanctuary known as Primarily Primates, Inc." The legislation directs the Secretary of Health and Human Services to take such steps as are necessary to enter into an agreement with Primarily Primates, Inc. The agreement is for the transfer of fifteen primates which were purchased with funds from an NIH grant to the Institute for Behavioral Research related to the effects of somatosensory deafferentation. The animals are currently in the custody of NIH and most are being cared for at the Delta Regional Primate Center in Louisiana.

The terms of the agreement outlined in H.R. 2883 are that Primarily Primates shall not transfer ownership or possession of the animals to any other party or allow any research to be conducted on such animals, other than research which is noninvasive and observational in nature. Primarily Primates is to "reimburse the U.S. for any expense relating to the maintenance of the animals ... incurred by the U.S. after the date of such transfer." The bill states it is not to be considered "to limit any right of the U.S. to recover expenses associated with the animals from a person who received, or used funds provided by" the grant referred to above.

When introduced on July 1, the bill had 6 co-sponsors, Hamilton Fish (R-NY), Frank Horton (R-NY), Tom Lantos (D-CA), Charlie Rose (D-NC), Patricia Schroeder (D-CO), and Gus Yatron (D-PA). As of September 8, there were 31 co-sponsors.

Concerned primatologists may write to their Representatives in Congress and express their opinion of this proposed legislation.

Meanwhile, on September 1, five untreated male cynomolgus control animals, accompanied by a veterinarian, were flown to the San Diego Zoo. According to a San Diego Zoo spokesperson, the animals arrived safely and will begin a re-socialization period of about one year before being placed in a smaller zoo elsewhere in California. The other nine animals involved in the IBR project will remain at Delta. A female rhesus monkey, another control, is now progressing rapidly toward full socialization with a male rhesus cagemate. The remaining eight macaques, all of which underwent surgical deafferentation during the IBR study, are doing as well as can be expected given serious and progressive spine abnormalities. Any attempt at socialization involving vigorous physical activity will put them at risk for broken necks or backs. Each will continue to require individual care until natural death, or, in conformance with animal welfare regulations, euthanasia is necessary. The Louisiana SPCA, in a report requested by the Governor, conducted a full review of the animals' health status and has recommended the animals be euthanized. However, no decision is expected before January.

Private funds covered the San Diego trip and will continue to defray the cost of care and maintenance of the animals at Delta.

State Legislatures Declare Support for Animal Research

The National Conference of State Legislatures has issued the following official policy concerning the use of animals in scientific research.

"The National Conference of State Legislatures firmly supports the use of federal, state and local authority to ensure the humane treatment of all animals. At the same time, the Conference recognizes the vital contribution made by animals to medical and scientific research. Without the use of animals in this research, few doubt that information critical to the identification of the causes or the cures for many life threatening diseases and injuries could not have been found or could have only been discovered after much longer delays and greater human suffering.

"We urge the Congress and the Administration, therefore, to exercise extreme caution in adopting any additional laws or regulations which would prohibit the use of animals in scientific or medical research or would impose such conditions as to make the cost of utilization prohibitive."

NIH Establishes Office of Animal Care and Use

The National Institutes of Health has established an Office of Animal Care and Use (OACU) to ensure that its intramural programs are in compliance with all Federal policies and rules on animal care and use. Dr. Robert A. Whitney, Jr., director of the NIH Division of Research Services and chief veterinary officer of the U.S. Public Health Service Commissioned Corps, has been appointed director of OACU, which is responsible to the NIH deputy director for intramural research, Dr. Joseph E. Rall.

Two veterinarian specialists in laboratory animal medicine are on the staff; Dr. Thomas L. Wolfle is deputy director and Dr. Martin Morin is associate director for assurance. They work closely with the NIH Animal Care and Use Committee, chaired by Dr. Whitney.

OACU also administers the Interagency Research Animal Committee, chaired by Dr. Whitney, which advises the Assistant Secretary for Health on animal-related matters affecting Federal programs. It serves as a liaison with other Federal agencies that sponsor or regulate the use of animals in research, testing, or training, as well as with international organizations on matters of animal care and use. A primary role of this committee is to foster the development of federally coordinated animal care and use policies within each participant agency.

Prisoners of Science

Jane Goodall published an article in the *New York Times* magazine on May 24, 1987, titled "Prisoners of Science: Chimpanzees in Medical Research." In it she called for better care and more understanding to improve the quality of life for chimpanzees used in necessary medical research. She writes, "Without doubt it

will be considerably more costly to maintain chimpanzees in [this manner]. Should we begrudge them the extra dollars? We take from them their freedom, their health and often, ultimately, their lives. Surely the least we can do is to try to provide them with some of the things which could make their imprisonment more bearable."

Macaquepit Monkey Business on 747

A monkey slipped out of its cage aboard a China Airlines cargo plane [before landing] at Kennedy Airport, forced the crew from the cockpit, and played with the controls before it was nabbed. "He wasn't making any demands--he wasn't trying to take the plane back home," said John Schneider, an animal control officer from the Port Authority who netted the 15-pound macaque monkey after a 90-minute game of hide-and-seek through the 747 jet. (The monkey had crawled out of the cargo area and into the flight deck.)--*[UPI, in San Francisco Chronicle, July 31, 1987.]*

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Revision of Directory of Graduate Programs in Primatology and Primate Research Planned

A revised Directory will be published in the January, 1988, issue of the *Laboratory Primate Newsletter*. If you wish to have your program listed or to revise your entry, please send us the necessary information, following the format shown here as closely as possible. Return the information as soon as possible, but not later than December 15, 1987, to Mrs. Janice Viticonte, Psychology Dept., Brown University, Providence, RI 02912. Please note that the Directory is not intended for post-doctoral programs, though any such sent to us will be listed separately.

- State:
- Institution:
- Division, Section, or Department:
- Program Name and/or Description:
- Faculty and Their Specialties:
- Address for Further Information:

* * *

Opinion: Scarce Resources and Endangered Species

Michael E. Soulé
Smithsonian Institution

A few flagship species are, today, receiving the lion's share of the funding. Is all the attention on a handful of endangered species really justified? I am often asked this question by sincere conservationists who are concerned with the apparent favoritism that is lavished on a few charismatic or cuddly animals, such as the peregrine falcon, the California condor, the black-footed ferret, the giant panda, the various rhinos, and other large vertebrates.

My usual, pat answers went something like this: I don't see a real problem with singling out a few species for special attention. Granted, it is undemocratic, perhaps even feudalistic, to grant special stays and dispensations to a few courtier species that happen to enjoy our condescension. But, we must look at the alternatives, and try to enumerate the advantages and disadvantages of this interspecific cronyism.

One justification for the present system, the "keystone principle," is that the favored species are often large animals, and therefore are keystone predators of major herbivores. There is increasing evidence that their disappearance from a community can initiate serious ripple effects. The propagation of these effects can lead to major changes in the interaction of species, and to disappearances of entire guilds such as ant-following and ground-nesting birds in the tropics and early successional stages (such as those created by browsing).

A second argument, also ecological, is the "umbrella argument;" it goes like this. Yes, the tiger and grizzly get special attention, but look at the benefits. These large generalist animals require a lot of space, and lots of habitat diversity. In addition, if our objective is to make a park or nature reserve that is large enough to hold a minimum viable population of these species, it must be huge--thousands of square kilometers in most cases. Therefore, a "trickle-down" effect of these space-intensive species is to provide a lot of habitat for other, less attractive species--species that need protection, but which lack sex appeal.

An implied assumption made by those who would support a more egalitarian allocation of scarce conservation funds is that if the funds were not spent on condors or tigers, they would be available for kangaroo rats, lizards, and rare plants and insects. Is it true? Often it isn't. It is a principle of fund raising that money that is given for one cause is not necessarily available for other, similar causes. This could be called the "niche theory of giving." That is, the people who contribute to Greenpeace to save baby seals and to the WWF to save pandas, won't give to buy hectareage of tropical forests or to support research on endangered snakes, and vice versa. The implication is that there isn't much we can do about democratizing conservation. So, we might as well spend the money on those species that are lucky enough to attract it.

Another principle of fund raising tends to soften the blow, however. This could be called the "cornucopia rule"--there is plenty of money out there; it is simply a matter of identifying the "universe" of donors who are interested in your cause,

and then making the correct pitch. Indeed there are societies to save endangered bats, fishes, and insects.

Adding all this up, it was easy to convince myself that one shouldn't be alarmed by conservation elitism. But, now, I'm not so sure. Let's re-examine the preceding arguments.

First, there are many species that don't profit from the keystone principle. The reason is that many charismatic species are really not ecological keystones. For example, the disappearance of condors, peregrines, whooping cranes, and even grizzlies from many regions would have very little impact that could not be dampened by counterpart species. Second, the trickle-down or umbrella effect, the *noblesse oblige* of animal emperors, really doesn't confer benefits on many smaller, threatened taxa. Many threatened species are habitat specialists whose ranges don't happen to coincide with those of their charismatic "benefactors."

Third, there are many species that require more than just space--they need special management interventions such as improved nesting sites, or denning sites. Other species must depend on management for the control of diseases, control of competitive or predatory exotic species, control of hydrological variables, or protection from humans. The world is so disturbed in many places that mere benign neglect is of little or no help.

Fourth, the cornucopia rule has only limited validity. It fails altogether in government agencies where funds are definitely finite, and where money spent on species A diminishes the pool of dollars for species B, C, and D. This can be a source of great anguish for many dedicated biologists in state and federal agencies, who must take from B in order to give to A, and who must risk the alienation of their colleagues in the process.

So, I am not so flippant about the supposed benefits and inevitability of our current caste system. But I don't know what to do about it.

One of the unspoken rules for the essayist is always to end on a positive, constructive note. I'd like to, but it would be premature. Perhaps it is time, though, to turn up the volume on this dialogue.--[From *Endangered Species*, Technical Bulletin Reprint, 4(2,3), 5.]

Michael Soulé is the president of the Society for Conservation Biology. He is currently a fellow in Biology at the Smithsonian Institution, Washington, D.C. 20560.

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NIH Workshop on PHS Policy

The National Institutes of Health, Office for Protection from Research Risks, is continuing to sponsor workshops on implementing the Public Health Service Policy on the Humane Care and Use of Laboratory Animals. The workshops are open to institutional administrators, members of animal care and use committees, laboratory animal veterinarians, investigators, and other institutional staff who have responsibility for high-quality management of sound institutional animal care and use programs. One workshop will be held on January 28-29, 1988, at Albuquerque, NM. Contact Ms Rynda Gibbs, University of New Mexico School of Medicine, Continuing Medical Education, 815 Vassar N.E., Albuquerque, NM 87131 [Phone 505-277-3942].

* * *

Symposium: Transplacental Effects on Fetal Health

A symposium on transplacental effects on fetal health will be held at the National Institutes of Health, Bethesda, Maryland on November 5-6, 1987. The purpose of this symposium is to present our current understanding of the mechanisms of action of biologic agents, the effects of disturbed maternal metabolism, and drug and chemical abuse on the developing fetus of humans and animals. Four major topics are: 1) Congenital Viral Infections 2) Congenital Bacterial and Other Infections 3) Metabolic, Drug and Chemical Teratogens 4) Genetic Engineering.

The symposium will be open and free-of-charge, and places will be reserved for at least 100 participants. Invitations will be given on a first-come, first-served basis. For further information contact George Migaki, DVM, Registry of Comparative Pathology, Armed Forces Institute of Pathology, Washington, D.C. 20306-6000; phone (202)576-2452.

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Recent Books and Articles

(Addresses are those of first authors)

Books

Apes of the World: Their Social Behavior, Communication, Mentality and Ecology. Russell H. Tuttle, Park Ridge, NJ: Noyes Publications, 1986. 405 pp. [Price: \$55]
.. .A comprehensive synthesis of results from research on apes since the classic work, *The Great Apes*, by Robert M. and Ada Yerkes in 1929. Contents: 1. Terminology, taxonomy, distribution, and phylogeny. 2. Positional behavior. 3. Feeding behavior. 4. Lodge sites and nesting. 5. Tool behavior 6. Brains and mentality. 7. Communication. 8. Sociality and sociobiology. 9. Synoptic

comparison of apes.

Health Benefits of Animal Research. William I. Gay (Ed.). Washington, DC: Foundation for Biomedical Research, 1986. 82 pp. [Paperbound. Price: \$7.50 plus \$2.50 postage and handling.]

...It is the intent of the authors of the various sections of this report to convey to the reader a sense of the value of biomedical research as well as the necessity for the use of animals in that research. It was prepared as a background document for the scientist or medical writer who seeks to improve the public's understanding of medical research. There are chapters on the mouse, the rabbit, the rat, the cat, and the dog, as well as one by Frederick A. King and Cathy J. Yarbrough, titled "Medical and Behavioral Benefits from Primate Research." That chapter has sections on atherosclerosis, aging, reproductive behavior, emotional expression, communication, infectious diseases, cancer, brain research, reproduction, surgery, dentistry and environmental health.

Official Lists and Indices of Names and Works in Zoology. International Commission on Zoological Nomenclature. 1987. [Price: \$110 from the Amer. Assn. Zoo. Nomenclature, c/o NHB Stop 163, Nat. Mus. Natural History, Washington, DC 20560. 60 pounds from the Internat. Trust Zoo. Nomenclature, British Mus. (Natural History), Cromwell Road, London SW7 5BD.]

The Biomedical Investigator's Handbook for Researchers Using Animal Models. Washington, D.C.: Foundation for Biomedical Research, 1987. 86 pp. [Paperbound. Price: \$10]

...This handbook reviews major ideas, techniques, and procedures related to the use of animals in the laboratory, including minimizing animal pain and distress, proper surgical techniques, choosing appropriate methods of euthanasia, and aspects of animal care and handling that can, if overlooked, ruin experimental results. Also included are the latest rules and regulations governing animal research, and a section devoted to the impact of the animal rights movement. There are also guidelines and recommendations on working with journalists, refuting the claims of animal rights advocates, and projecting a positive image to the public.

Bibliographies

Animal Models of Toxicant Pharmacokinetics: Species Differences of Nonhuman to Human Primates or Other Animals: A Bibliography, 1979-1987. B. Caminiti. Seattle: Primate Information Center, 1987. 17 pp., (171 citations, primate index). [Price: \$7.50, plus \$3.00 per invoice. Send order to Primate Information Center, Regional Primate Research Center SJ-50, University of Washington, Seattle, WA 98195.] An update (1983-87, 57 citations) in loose pages is available at \$3.00 only for those customers who purchased the 1984 edition.

Environmental Enrichment for Captive Nonhuman Primates: A Bibliography: 1972-

1987. J. B. Williams. Seattle: Primate Information Center, 1987. 5 pp. (57 citations). [Price: \$4.50, plus \$3.00 per invoice. Ordering information same as above.]

Reports

REP: Annual Report 1986. Rijswijk, The Netherlands: Division for Health Research TNO, 1986.

... This is the annual report of the REP Institutes, which stands for the Radiobiological Institute TNO, Institute for Experimental Gerontology TNO, and Primate Center TNO, Rijswijk Z.H., The Netherlands. Of the many short notes describing the accomplishments of the organization, the following are concerned with primates: IMMUNOLOGY AND TRANSPLANTATION BIOLOGY. Sequential administration of CD4 specific monoclonal antibodies in rhesus monkeys, by M. Jonker and J. A. H. M. den Brok. T-cell specific monoclonal antibodies abolish the blood transfusion effect on kidney allograft survival in rhesus monkeys, by G. den Butter, M. Jonker, F. J. M. Nooij, R. van Schilfgaarde and A. A. van Es. EXPERIMENTAL HEMATOLOGY AND CELL BIOLOGY. Purification of rhesus monkey haemopoietic stem cells, by J. J. Wielenga, W. R. Gerritsen, G. Wagemaker and D. W. van Bekkum. MICROBIOLOGY. Hepatitis delta infection in chimpanzees, by A. Kos, M. Dubbeld, A. de Reus, J. Wubben and H. Schellekens. Infection of rhesus monkeys with a type D retrovirus causing an immunodeficiency syndrome, by W. van Vreeswijk, H. Niphuis, M. A. Dubbeld, L. J. Lowenstine and P. A. J. Bentvelzen. Antibodies to the human immunodeficiency virus in infected chimpanzees, by W. H. Koornstra, J. T. Overdeest, R. H. Dubbes, R. van den Akker, A. A. van Es and P. A. J. Bentvelzen. Antiviral activity of a human interferon analogue in rhesus monkeys, by A. H. Borman, P. H. van der Meide and H. Schellekens. ETHOLOGY. Alcohol drinking by rhesus monkeys: Abstinence induced "catch-up" drinking is mediated by opioid receptors, by M. Kornet, C. Goosen, L. G. Ribbens and J. M. van Ree. Housing conditions and the ontogeny of stereotyped locomotion and abnormal self-directed activities in rhesus monkeys, by C. Goosen.

Primate Report, No. 16, March, 1987. [Published in cooperation with the German Primate Center (DPZ).] [Price: \$8.00]

... This issue includes some of the Proceedings of the XIth Congress of the International Primate Society, 20-25 July, 1986, Göttingen, FRG. The papers published here are: Neuroendocrine control of sexual initiating behaviour in the female common marmoset (*Callithrix jacchus*), by A. F. Dixson. Influence of female behavior and endocrine status on sexual initiation in rhesus monkey groups, by J. G. Herdon, M. C. Ruiz de Elvira and J. J. Turner. Sexual initiation in stump-tail macaques (*Macaca arctoides*), by D. Q. Estep. Sexual initiation in common chimpanzee, gorilla and orang-utan, by R. D. Nadler. Sexual initiation in captive group of pygmy chimpanzees (*Pan paniscus*), by J. F. Dahl. Semantic and pragmatic meaning: Toward the analysis of meaning in primate signs, by J. Liska. Aunting, alloparenting, infant handling: Evolving views of adaptive function, by D. Quiatt. A preliminary clinical investigation using simple urological techniques in

determinating urinary tract disease in a colony of *Callitrichidae*, by T. J. Gatesman.

Booklets

Veterinary Biologics: Use and Regulation. Hyattsville, MD: USDA-APHIS-VS, 1987. 8pp. [Free. Order from Public Awareness, USDA-APHIS-LPAS, 700 Federal Building, Hyattsville, MD 20782.]

...This booklet explains the many uses of veterinary biologics.

Anatomy

A sternal gland in the siamang gibbon (*Hylobates syndactylus*). Geissmann, T. (Anthropological Institute, University Zürich -Irchel, Winterthurerstrasse 190, CH-8057 Zürich, Switzerland.) *International Journal of Primatology*, 1987, 8, 1-15.

...The present report gives the first description of a sternal gland in the siamang gibbon, and the first histological examination of a sternal gland in a hominoid primate other than the orangutan.

Interrelation between ischium, thigh extending muscles and locomotion in some primates. Yirga, S. (Primate Research Institute, Kyoto University, Inuyama, Aichi, 484 Japan.) *Primates*, 1987, 28, 79-86.

...The relative lengths of the ischium and the thigh extending muscles are compared in macaques, the guereza, the chimpanzee, the gibbon, the slow loris, and the grand and lesser bush babies. Discussing the ischium in relation with the hamstring muscles alone is not satisfactory, since the ischium serves the thigh extending muscles, including *adductor magnus* and *quadratus femoris ventralis*, attached on it as a lever. A long lever, in these cases the ischium, is an indication of the relatively heavy muscles that originate from it.

Animal Models

Tamarin model of pneumococcal bacteremia. Chudwin, D. S., Artrip, S. G., Ogden, J. D. and Schiffman, G. (Dept. of Immunology/Microbiology, Rush Medical College, 1753 West Congress Parkway, Chicago, IL 60612.) *Journal of Medical Primatology*, 1987, 16. 249-260.

...Tamarins (*Saguinus labiatus*) were utilized to study host defenses against pneumococcal bacteremia. Tamarins had a poor antibody response to immunization with varying doses of pneumococcal capsular polysaccharide (PCP) vaccine or to infection with serotype 7F *Streptococcus pneumoniae*. Tamarins were protected against challenge with a lethal dose of serotype 7F *S. pneumoniae* if the bacteria were preopsonized with human immune globulin intravenous or if the tamarins were injected with the immune globulin 30 min before challenge. There was minimal protection utilizing a mouse monoclonal anti-type 7F PCP antibody.

Experimental American leishmaniasis in the Brazilian squirrel monkey (*Saimiri*

sciureus): Lesions, hematology, cellular, and humoral immune responses. Pung, O. J. and Kuhn, R. E. (Dept. of Biology, Box 7325, Wake Forest University, Winston-Salem, NC 27109.) *Journal of Medical Primatology*, 1987, 16, 165-174.

...Unulcerated cutaneous lesions appeared and persisted in squirrel monkeys experimentally infected with *Leishmania braziliensis braziliensis* or *L. b. panamensis*. Peripheral blood mononuclear cell (PBMC) numbers increased following infection, and cultured PBMCs from infected monkeys proliferated in response to parasite antigens. The responses of PBMCs to mitogens were not suppressed in infected monkeys. Elevated levels of leishmania-specific immunoglobulins M and G were also observed. Thus, the squirrel monkey is susceptible to American leishmaniasis and is capable of responding to the infection with measurable cellular and humoral immunity.

Hemodynamic and echocardiographic evaluation of the stumptailed macaque: A potential nonhuman primate model for pulmonary vascular disease. Weesner, K. M. and Kaplan, K. (Dept. of Pediatrics, Comparative Medicine, Bowman Gray School of Medicine, Wake Forest University, Winston-Salem, NC 27103.) *Journal of Medical Primatology*, 1987, 16, 185-202.

...Stumptailed macaques (*Macaca arctoides*) were evaluated as to their suitability as an animal model for pulmonary hypertension. Hemodynamic measurement including pulmonary artery pressure response to 12% oxygen exposure identified three groups of animals with elevated, normal, and intermediate pulmonary artery pressures. Stumptailed macaques with elevated pulmonary artery pressure could be distinguished from other animals by echocardiography.

Behavior

Infanticide in a chacma baboon troop. Tarara, E. B. (Institute of Primate Research, Box 24481, Karen, Nairobi, Kenya.) *Primates*, 1987, 28, 267-270.

...This report describes an infanticide and two attacks of an infant and a juvenile by a natal adult male in a troop of chacma baboons (*Papio ursinus*). The infanticidal male had become the dominant male in his troop five months before the infanticide, suggesting that a trigger for infanticidal behavior is a rise in rank to dominant status.

Rhythm and melody in gelada vocal exchanges. Richman, B. (2200 Oakdale, Cleveland Heights, OH 44118.) *Primates*, 1987, 28, 199-223.

...A scheme for describing how gelada monkeys (*Theropithecus gelada*) use rhythm and melody in their vocal exchanges with each other is presented. Many examples of gelada rhythm and melody are demonstrated from sonographs. It is argued that geladas use rhythm and melody in their vocal exchanges in ways that are similar to how humans use rhythm and melody in speech and singing.

Infanticide among free-ranging langurs (*Presbytis entellus*) at Jodhpur (Rajasthan/India): Recent observations and a reconsideration of hypotheses. Sommer, V. (Dept. of Zoology, University of Jodhpur, Jodhpur 342 002, Rajasthan,

India.) *Primates*, 1987, 28, 163-197.

...Detailed observations are presented about two noninfanticidal and three infanticidal male changes including six eye-witness and five presumed cases of infanticide within three langur troops during a long-term study at Jodhpur, Rajasthan, India. The results do not support any explanatory hypotheses focussing on social crowding, regulation of population density, social stress, sexual frustration, incest avoidance, or social bonding, but are in general though not total agreement with the reproductive advantage hypothesis.

The acquisition process of a novel behavior pattern in a group of ring-tailed lemurs (*Lemur catta*). Kappeler, P. M. (Abt. für Verhaltensphysiologie, Beim Kupferhammer 8, D 7400, Tübingen 1, DFR.) *Primates*, 1987, 28, 225-228.

...The process of acquisition and propagation of a novel behavior pattern in a group of 18 *Lemur catta* was examined. Six of eight animals that acquired the new habit were infants or juveniles. Adult males did not take up the new behavior pattern. Effects of rank and kinship on the acquisition process were not obvious.

Social responses to the traumatic injury of a juvenile spider monkey (*Ateles geoffroyi*). Chapman, C. A. and Chapman, L. J. (Dept. of Anthropology, University of Alberta, Edmonton, Alberta, T6G 2E1, Canada.) *Primates*, 1987, 28, 271-275.

...The behavioral development of a juvenile male spider monkey preceding and subsequent to a traumatic injury resulting in the loss of his tail, was documented over a nine-month period in Santa Rosa National Park, Costa Rica. The juvenile became heavily reliant on his mother, who readily provided compensatory care, including nursing the juvenile even though he had previously been weaned. In comparison to another juvenile male spider monkey of similar age, the development of the injured animal was severely retarded and even five months after the accident, the juvenile was still nursing and being carried by his mother. As injuries may be relatively common among primates it is suggested that the provision of compensatory care is an important trait in many primate species.

A new interpretation of the social organization and mating system of the callitrichidae. Sussman, R. W. and Garber, P. A. (Dept. of Anthropology, Washington University, St. Louis, Missouri 63130.) *International Journal of Primatology*, 1987, 8, 73-92.

...This paper proposes that the Callitrichidae tend to live in small multimale-multifemale groups, communally rear the young of one female, and exhibit a mating pattern characterized by female promiscuity but a breeding system that is functionally polyandrous. There is a significant correlation between the number of males in a group and the total number of surviving young. The possible adaptive advantages of this social organization are discussed.

Ranging, activity rhythms, and sociality in free-ranging *Tarsius bancanus*: A preliminary report. Crompton, R. H. and Andau, P. M. (Dept. of Human Anatomy and Cell Biology, The University, P. O. Box 147, Liverpool, L69 3BX, UK). *International Journal of Primatology*, 1987, 8, 43-71.

...Two male and two female western tarsiers were followed in primary and secondary lowland rainforest using radiotelemetry. The present evidence suggests that the social organization resembles that of Lorinae and some Galaginae, but with much less direct or close contact, and does not tend to support arguments for the existence of monogamy or pair bonding in this species.

Variability and stability in the rank relations of nonhuman primate females: Analysis by computer simulation. Hausfater, G., Cairns, S. J., and Levin, R. N. (Division of Biological Sciences, 110 Tucker Hall, University of Missouri, Columbia, MO 65211.) *American Journal of Primatology*, 1987, 12, 55-70.

... The present analyses suggest that differences between species in the degree of nepotism and age-gradedness characteristic of their female rank orders does not in and of itself constitute evidence that the females of those species use markedly different strategies of rank acquisition.

Mirror guided behavior in Japanese monkeys (*Macaca fuscata fuscata*). Itakura, S. (Primate Research Institute, Kyoto University, Inuyama, Aichi, 484 Japan.) *Primates*, 1987, 28, 149-161.

...Two male Japanese monkeys were trained to use a mirror to reach an object that could not be seen directly. Training to use a mirror in this way proceeded, step-by-step, from reaching a piece of apple to key-tracking. Mirror guided behavior such as shown here has not previously been demonstrated in monkeys.

Are male rhesus monkeys more aggressive than females? Reinhardt, V. (Wisconsin Regional Primate Center, University of Wisconsin, 1223 Capitol Court, Madison, WI 53715-1299.) *Primates*, 1987, 28, 123-125.

...The justification for the generalization that primate males are more aggressive than females was tested in a troop of 24 captive rhesus monkeys. Males were more dominant than females, i.e. they had more subordinate partners, hence, their aggression rate was higher. However, adjusting the rate of aggression according to the number of subordinate targets revealed no gender difference and males directed numbers of aggressive acts against individual subordinate partners that were not higher than those of females. It was concluded that aggressiveness is an individual attribute that is (1) independent of dominance status, and (2) independent of sex.

Sibships: Cooperation and competition among immature vervet monkeys. Lee, P. C. (Sub-department of Animal Behaviour, Madingley, Cambridge CB3 8AA, UK.) *Primates*, 1987, 28, 47-59.

...The relationships between siblings were compared with those between nonsibling peers among immature vervet monkeys (*Cercopithecus aethiops*) in three free-ranging social groups.

Correlates of agonistic and competitive interactions in pregnant baboons. Silk, J. B. (Dept. of Anthropology, University of California, Los Angeles, CA 90024.) *American Journal of Primatology*, 1987, 12, 479-495.

. . . Recently, primatologists have suggested that certain characteristics of the fetus may influence maternal condition. For example, among captive pigtailed macaques (*Macaca nemestrina*) mothers of female infants may be at greater risk of injury during their pregnancies than mothers of male infants. Analysis of the rates of aggression, submission, competition, and wounding among free-ranging pregnant baboons (*Papio cynocephalus*) in Amboseli National Park generally fail to support these findings, but several other factors such as maternal dominance rank, environmental conditions during pregnancy, maternal parity, and fetal age correlate with aggression, submission, competition, and injuries sustained by pregnant female baboons.

The manufacture and use of tools by capuchin monkeys (*Cebus apella*). Westergaard, G. C. and Fragaszy, D. M. (CDMRC, WJ-10, University of Washington, Seattle, WA 98195.) *Journal of Comparative Psychology*, 1987, 101, 159-168.

. . . These studies provide the first report of spontaneous manufacture of tools in any group of monkeys. The tool-using and manufacturing behaviors observed in the capuchins were similar in form, function, and ontogeny to those that have previously been reported for chimpanzees.

Intra- and inter-group interactions of an all-male group of Virunga mountain gorillas (*Gorilla gorilla beringei*). Yamagiwa, J. (Japan Monkey Centre, Inuyama, Aichi, 484 Japan.) *Primates*, 1987, 28, 1-30.

. . . Six unrelated male gorillas formed an all-male group within the Virunga mountain gorilla population. Frequent homosexual interactions characterized the high cohesiveness of this group. The group's formation may be related to recent social change in the Virunga gorilla population.

Chimpanzees using stones to crack open oil palm nuts in Liberia. Hannah, A. C. and McGrew, W. C. (Dept. of Psychology, University of Stirling, Stirling FK9 4LA, Scotland.) *Primates*, 1987, 28, 31-46.

. . . The use of stone-tools to open palm nuts (*Elaeis guineensis*) was studied in a group of 16 chimpanzees (*Pan troglodytes*) released from captivity to a natural island setting in Liberia. These are the first detailed behavioral data on palm-nut-cracking, and they show many parallels with cracking of other species of nuts by chimpanzees of the Tai Forest, Ivory Coast. This is another example of hammer-stone use from a limited region of West Africa: southeastern Guinea, eastern Liberia, and western Ivory Coast. This suggests limited cultural diffusion of the custom.

Biochemical Taxonomy

Origin and evolution of the Sulawesi macaques 1. Electrophoretic analysis of hemoglobins. Takenaka, O., Hotta, M., Takenaka, A., Kawamoto, Y., Suryobroto, B. and Brotoisworo, E. (Primate Research Institute, Kyoto University, Inuyama, Aichi, 484 Japan.) *Primates*, 1987, 28, 87-98.

. . . The monkeys on the island of Sulawesi (Celebes), Indonesia, comprise seven

species of *Macaca*. Hemoglobins from 248 individuals of these seven species were analyzed by isoelectric focusing electrophoresis (IEFE) and by starch gel electrophoresis in the presence of urea (USGE).

Origin and evolution of the Sulawesi macaques 2. Complete amino acid sequences of seven beta chains of three molecular types. Takenaka, O., Hotta, M., Kawamoto, Y., Suryobroto, B. and Brotoisworo, E. (Primate Research Institute, Kyoto University, Inuyama, Aichi, 484 Japan.) *Primates*, 1987, 28, 99-109.

...Seven beta chains were identified as the typical molecular types carried by the seven species of Sulawesi macaques based on isoelectric focusing and urea starch gel electrophoresis.

Banding patterns of the chromosomes of *Cebus apella*: Comparative studies between specimens from Paraguay and Argentina. Mudry De Pargament, M. and Slavutsky, I. R. Sección Citogenética, Instituto de Investigaciones Hematológicas, Academia Nacional de Medicina, J. A. Pacheco de Melo 3081 (1425), Buenos Aires, Argentina. *Primates*, 1987, 28, 111-117.

...This paper presents a comparative study of the karyotypes of *Cebus apella* (Platyrrhini, Cebidae) from two different regions of South America: Paraguay and Argentina. Forty-two adult animals were analyzed; similar karyotypes were observed in both groups. Different chromosome aberrations were found in specimens from Paraguay and Argentina. These findings support the intraspecific variability of these New World monkeys.

Disease

Gastric trichobezoar in a baboon. Butler, T. M. and Haines, J. J. Jr. (Dept. of Laboratory Animal Medicine, Southwest Foundation for Biomedical Research, San Antonio, TX 78284.) *Laboratory Animal Science*, 1987, 37, 232-233.

...A four year old, 9.4 kg female baboon was found in an outdoor corral with a draining opening in the abdominal wall just distal to the sternum. After a large firm mass was palpated, a laparotomy was performed. The opening communicated directly with the gastric lumen which contained a 1.0 kg trichobezoar. The gastric serosal surface surrounding the opening was adhered to the abdominal wall. The hairball was removed and the baboon made an uneventful recovery.

Tetanus in baboons of a corral breeding colony. Goodwin, W. J., Haines, R. J., and Bernal, J. C. (Dept. of Laboratory Animal Medicine, Southwest Foundation for Biomedical Research, San Antonio, TX 78284.) *Laboratory Animal Science*, 1987, 37, 231-232.

...Tetanus caused by *Clostridium tetani* is seldom a problem in nonhuman primates housed in individual cages or in pens with solid floors that are cleaned frequently. This organism is found in the soil and enters the body primarily through wounds. Therefore, it is a potential health problem in nonhuman primates being maintained on islands and in corrals. In 1982, five cases of tetanus

were diagnosed in baboons, *Papio cynocephalus anubis*, of a 6 acre corral breeding colony located at the Southwest Foundation for Biomedical Research. To prevent further cases, all animals were captured and vaccinated with veterinary toxoid. Tetanus toxoid is now administered routinely to all young animals annually, and a booster vaccination is given every 5 years. Tetanus has not been diagnosed since.

Fatal fatty liver-kidney syndrome in obese monkeys. Laber-Laird, K. E., Jokinen, M. P., and Lehner, N. D. M. (Dept. of Comparative Medicine, Bowman Gray School of Medicine of Wake Forest University, Winston-Salem, NC 27103.) *Laboratory Animal Science*, 1987, 37, 205-209.

.. A fatal syndrome associated with brief periods of anorexia or acute weight loss was noted in monkeys. Affected monkeys died unexpectedly or after a very short illness. Consistent gross findings at necropsy were enlarged, pale yellow livers, pale tan to yellow kidneys, abundant deposits of body fat and empty gastrointestinal tracts. Fatty change of the liver and kidney was the predominant and characteristic lesion found microscopically. Most of the monkeys were female *Macaca fascicularis* greater than 8 years of age. However, monkeys of other species and ages, and one male also died of this syndrome. Affected monkeys generally had losses of 8-33% of body weight. In some animals, this syndrome was associated with a location change forcing new social interactions. A common clinical pathologic finding was azotemia.

Bovine tuberculosis in a wild baboon population: Epidemiological aspects. Sapolsky, R. M. and Else, J. G. (Dept. of Biological Science, Stanford University, Stanford, CA 94305.) *Journal of Medical Primatology*, 1987, 16, 229-235.

.. A follow-up of an outbreak of *Mycobacterium bovis* in a population of feral baboons in Kenya was undertaken after one year by necropsy of euthanized, clinically ill animals, and tuberculin testing of others. It was concluded that the source of the infection was animals feeding on village slaughterhouse offal of *M. bovis* infected cows. Secondary (direct) baboon-baboon transfer of the disease appeared to be minimal or nonexistent.

Sarcocystis found in the skeletal muscle of common squirrel monkeys. Kimura, T., Ito, J., Suzuki, M. and Inokuchi, S. (Dept. of Anatomy, Showa University School of Medicine, Shinagawa-ku, Tokyo, 142 Japan.) *Primates*, 1987, 28, 247-255.

.. Abnormally enlarged muscle fiber cells of ring form were incidentally detected in transverse sections of muscles of the common squirrel monkey during microscopic investigation of the composition of muscle fibers. Detailed examination of longitudinal sections revealed slender capsule-like *Sarcocystis* cysts in the sarcoplasm. Staining with Sudan black B revealed that this parasite selectively infested type II white fibers with a large diameter and a high glycogen content.

Mycobacterium paratuberculosis infection in a colony of stump-tail macaques (*Macaca arctoides*). McClure, H. M., Chiodini, R. J., Anderson, D. C., Swenson, R. B., Thayer, W. R. and Coutu, J. A. (Yerkes Regional Primate Research Center, Emory

University, Atlanta, GA 30322.) *The Journal of Infectious Diseases*, 1987, 155, 1011-1019.

...*Mycobacterium paratuberculosis* infection was documented in a colony of stump-tail macaque monkeys with 29 (76%) of 38 monkeys infected and shedding organisms in feces. Thirteen deaths have occurred during the past five years. The clinical and pathological features of paratuberculosis in this species were comparable to those reported for paratuberculosis in ruminants and *Mycobacterium avium* infections in primates. These findings extend the natural host range of *M. paratuberculosis* to include nonhuman primates and add support to current suggestions that *M. paratuberculosis* may be pathogenic for humans.

Ecology

A field observation of predation on a moustached tamarin (*Saguinus mystax*) by an anaconda. Heymann, E. W. (AG Ethologie, Deutsches Primatenzentrum, Kellnerweg 4, 3400 Göttingen, DFR.) *International Journal of Primatology*, 1987, 8, 193-195.

...The first observation of snake predation on a New World callitrichid monkey.

Responses of rain-forest primates to habitat disturbance: A review. Johns, A. D. and Skorupa, J. P. (Ecology Graduate Group, Dept. of Anthropology, University of California, Davis, CA 95616.) *International Journal of Primatology*, 1987, 8, 157-191.

...Body size alone is a poor predictor of primate response to moderate forest disturbance. However, when the effects of diet variables are held constant, body size more strongly correlates with survival ability (smaller species surviving better). Degree of frugivory shows a significant negative correlation with survival ability, while dietetic diversity is not correlated with survival ability. Idiosyncratic responses of species can usually be traced to specific features of the changing environment, such as selective elimination of important food sources and, conversely, the presence of increased densities of particular food sources arising from the disturbance.

Notes on the distribution of *Lepilemur septentrionalis* and *L. mustelinus* in northern Madagascar. Ratsirarson, J., Anderson, J., Warter, S. and Rumpler, Y. (Service des Eaux et Forêts, Tananarive, Madagascar.) *Primates*, 1987, 28, 119-122.

... This paper gives new information concerning the present southern limits of *Lepilemur septentrionalis* and northern limit of *L. mustelinus*. This information is important in view of the habitat destruction and human predation threatening the wildlife of Madagascar.

Comparability among measures of primate diets. Kurland, J. A. and Gaulin, S. J. C. (Dept. of Anthropology, Pennsylvania State University, University Park, PA 16802.) *Primates*, 1987, 28, 71-77.

...Our picture of primate feeding niches is suspect because field workers have used a variety of observational techniques to assess diet in the wild. Here the

question of the comparability of these techniques is explored empirically, by comparing the dietary profiles of a small group of primate species that have been studied by two methods in a single locality. These methods are shown to yield quite different results, in both simple description and behavioral-ecological hypothesis testing.

Ecological constraints on the grouping of wild orang-utans (*Pongo pygmaeus*) in the Gunung Leuser National Park, Sumatra, Indonesia. Sugardjito, J., te Boekhorst, I. J. A. and van Hooff, J. A. R. A. M. (I. J. A. te Boekhorst, Laboratory of Comparative Physiology, State University of Utrecht, Jan van Galenstraat 40, 3572 LA Utrecht, The Netherlands.) *International Journal of Primatology*, 1987, 8, 17-41.

...The orangutan is an interesting subject on which to base an evaluation of the costs and benefits of social life in apes, since grouping in this heavy, arboreal frugivore is facultative. In the Ketambe area of Sumatra, Indonesia, the food sources of wild orangutans display a clear seasonality. It is suggested that the development of social skills is an important aspect of grouping in adolescent orangutans. For the adult male, safeguarding his reproductive success by protecting females against sexually aggressive subadult males is probably the only reason for being in groups.

The surreptitious life of the saddle-backed tamarin. Terborgh, J. and Stern, M. (Dept. of Biology, Princeton University, Princeton, NJ 08544.) *American Scientist*, 1987, 75, 260-269.

...The saddle-backed tamarin is a very small South American monkey whose use of food resources may help us understand why some species are plentiful and others rare. For ten months of the year, tamarins are frugivores, harvesting fruit from a succession of small trees rather than filling themselves at a few large trees as larger primates do. During part of the dry season, the tamarins become nectarivores, feeding on nectar from two plants. Because these two critical resources occur in distinct forest types, the territories of tamarins are larger and more heterogeneous than those of other monkeys living in the same environment. The population density of tamarins is consequently lower.

Immunology

Distribution of immunoglobulin allotypes among local populations of Kenya olive baboons. Olivier, T. J., Coppenhaver, D. H. and Steinberg, A. G. (Department of Anthropology, Yale University, 51 Hillhouse Ave., New Haven, CT 06511.) *American Journal of Physical Anthropology*, 1986, 70, 29-38.

...This paper reports on the distributions of immunoglobulin allotypes among 564 olive baboons collected at six localities in Kenya. The proportions of individuals positive for polymorphic allotypes varied substantially between different local samples, as did the arrays and estimated frequencies of haplotypes. Allotype frequencies in local samples do not appear to be simply related to either geographic location or habitat characteristics of the localities. The data suggest that much of the geographic variability in Kenya olive baboon populations occurs

between populations separated by small geographic distances.

Instruments and Techniques

Iliac biopsy for histomorphometric analysis of trabecular bone in cynomolgus monkeys and baboons. Goodwin, B. T. and Jerome, C. P. (Dept. of Comparative Medicine, Bowman Gray School of Medicine, Winston-Salem, NC 27103.)

Laboratory Animal Science, 1987, 37, 213-216.

.. A humane, repeatable surgical technique was developed to harvest trabecular bone for histomorphometry from nonhuman primates. Using a direct surgical approach to the iliac crest, bone specimens were harvested from cynomolgus monkeys and baboons. The method provides bone samples with little artifact or bone dust contamination, and easy orientation and reproducibility of the plane of section. None of the cynomolgus monkeys were affected adversely by the surgery, but the baboons were quieter than normal for 12-24 hours afterward.

Nutrition

Failure to induce weight gain with palatable diets in monkeys (*Macaca mulatta*). Jen, K.-L. C. (Dept. of Nutrition and Food Science, Wayne State University, 160 Old Main, Detroit, MI 48202.) *Primates*, 1987, 28, 61-69.

.. Three diets popularly used to produce obesity in rodents were offered to male rhesus monkeys. A high fat diet (fat: 50% of calories) enhanced the daily caloric intake of the monkeys, but only slight and nonsignificant increases in body weight were observed over a period of six weeks. However, an increase in feeding efficiency was observed. Providing monkeys with an assorted, palatable supermarket diet failed to induce them to overeat. There were no changes in total caloric intake or in body weight. When the monkeys were supplemented with a bottle of 32% sucrose solution, in addition to a commercial monkey biscuit and tap water, a significant increase in caloric intake was observed, but no change in body weight occurred. Thus, palatable and calorically dense diets failed to induce sufficient increases in intake to produce change in body weight in nonhuman primates. Based on these results, only the high fat diet has much potential to produce obesity, and such obesity, if it occurs, will likely require long-term experiments.

A preliminary list of chimpanzees' alimentation at Bossou, Guinea. Sugiyama, Y. and Koman, J. (Primate Research Institute, Kyoto University, Inuyama, Aichi, 484 Japan.) *Primates*, 1987, 28, 133-147.

.. A preliminary list of all the plant and animal foods for wild chimpanzees at Bossou, southeast of the Republic of Guinea, is presented for comparison with that of other study areas and as the basic data for the further studies. Altogether 205 food items (species x part eaten) from 156 species in 106 genera of plant food are recorded. As calculated from number of food items, fruits and seeds (nuts) occupy more than half of the diet; and leaves shoots, and twigs (stems) constitute about one third.

Evaluation of serum parameters relevant to vitamin D status in tamarins. Flurer, C. I. and Zucker, H. (Institute für Physiologie, Physiologische Chemie und Ernährungsphysiologie, Tierärztliche Fakultät der Universität München, West Germany.) *Journal of Medical Primatology*, 1987, 16, 175-184.

...Serum levels of 25(OH)D, alkaline phosphatase (AP), and parathormone (PTH) were evaluated to investigate the vitamin D requirement of *Saguinus fuscicollis*. Diets with various vitamin D content were fed 4 weeks and longer. The values of 25(OH)D (30-300 nmol/l), AP (<300 U/l), and PTH (<=1,000 equl/l) considered as normal were obtained with 2,000 IU D3/kg diet, or 33 IU/animal/day, which we regard as the level required. Animals depleted of vitamin D for 215 days developed a secondary hyperparathyroidism.

Pathology

Oral-facial clefts and associated malformations in the squirrel monkey (*Saimiri sciureus*). Hoopes, C. W. and Jerome, C. P. (Department of Comparative Medicine, Bowman Gray School of Medicine, Winston-Salem, NC 27103.) *Journal of Medical Primatology*, 1987, 16, 203-209.

...Of the 414 squirrel monkey pregnancies recorded at this institution since 1977, seven (1.7%) have resulted in offspring with clefts of the lip and/or palate. Associated malformations include a ventricular septal defect, renal agenesis, anal atresia, axial skeletal anomalies, and craniorachischsis (anencephaly and spina bifida). Three of these infants are the result of consanguineous matings.

Physiology

Separation distress in infant rhesus monkeys: effects of diazepam and RO 15-1788. Kalin, N. H., Shelton, S. E., and Barksdale, C. M. (William S. Middleton Memorial Veterans Hospital, Madison, WI 53705.) *Brain Research*, 1987, 408, 192-198.

...This paper examines the effect that altering benzodiazepine systems has on the behavioral and endocrine response of infant rhesus monkeys to brief separation from their mothers. The data support the hypothesis that in primates, endogenous benzodiazepine systems modulate the behavioral and endocrine response to the naturally occurring stress of separation.

Discriminant analysis of hematological and serum biochemical values in cynomolgus monkey (*Macaca fascicularis*) bred and reared under the indoor individually-caged conditions. Yoshida, T., Cho, F., and Goto, N. (Tsukuba Primate Center for Medical Science, National Institute of Health Hachimandai, Yatabe-machi, Tsukuba-gun, Ibaragi-Ken 305, Japan.) *Experimental Animals*, 1987, 36, 245-251. (Japanese, with English summary)

...The data on hematological and serum biochemical properties of 1086 laboratory-bred cynomolgus monkeys in 10 age groups were analyzed by discriminant analysis.

Comparative radionuclide and thermodilution determinations of cardiac output

and stroke volume in the baboon (*Papio ursinus*). Dormehl, I. C., Bosman, H., Hugo, N., Maree, M., van Vuuren, C., van Zandwyk, C., van Aswegen, A. and Paterson, L. (AEC Institute of Life Sciences, P.O. Box 2034, Pretoria, 0001, South Africa.) *Journal of Medical Primatology*, 1987, 16, 139-150.

...Thermodilution cardiac output determinations and multigated equilibrium blood-pool scintigraphy were performed in ten healthy chacma baboons. The correlation was moderately good between both the radionuclide and thermodilution stroke volume ($r = 0.58$, $SEE = 3$ ml; $SV(th) = 0.78SV(r) + 15.6$ ml) as well as the cardiac output ($r = 0.72$, $SEE = 0.2$ liter/min; $CO(th) = 0.56 Co(r) + 2.1$ liter/min). The attenuation depth $d(r)$ as determined by radionuclide techniques was found to correlate well with the radiologically determined values $d(x)$ ($r = 0.8$, $SEE = 0.4$ cm; $d(x) = 0.87d(r) + 0.72$ cm) which validated the depth values used in the calculations.

Auditory frequency discrimination in primates: Species differences (*Cercopithecus, Macaca, Homo*). Sinnott, J. M., Owren, M. J. and Petersen, M. R. (Psychology Department, Indiana University, Bloomington, IN 47405.) *Journal of Comparative Psychology*, 1987, 101, 126-131.

...Auditory frequency difference limens (DLs) at 2 kHz were measured in Old World monkeys and humans using a go/no-go repeating standard procedure and positive reinforcement operant conditioning techniques. Quantitative and qualitative differences occurred between monkey and human sensitivity. Results are related to other comparative psychoacoustic data and primate vocal communication, including human speech.

Reference values for peripheral blood lymphocytes from *Aotus lemurinus* ssp. *griseimembra* (owl monkey). Caldwell, C. W., Mrema, J. E. K., Taylor, H. M. and Green, T. J. (Dept. of Pathology, University of Missouri School of Medicine, Columbia, MO 65212.) *Journal of Medical Primatology*, 1987, 16, 261-171.

...The reactivities of several monoclonal antibodies that define human lymphocyte cell-surface antigens have been tested with peripheral blood lymphocytes of *Aotus lemurinus* ssp. *griseimembra*. Based on reactivity patterns in humans, reactive MoAb were identified that mark pan-T, helper/inducer, suppressor/cytotoxic, pan-B, and natural killer cells. Reference values of these subsets in *Aotus* are presented. These MoAb should provide a useful tool for further phenotypic and functional dissection of the immune system in this simian model of human disease.

Correlative clinical biochemistry and hematological profiles of laboratory-bred Bolivian squirrel monkeys (*Saimiri sciureus*). Kakoma, I., James, M. A., Jackson, W., Montealegre, F., Bennett, G., Carpunky, P. and Ristic, M. (Dept. of Pathobiology, University of Illinois, College of Veterinary Medicine, Urbana, IL 61801.) *Journal of Medical Primatology*, 1987, 16, 273-276.

...Twenty-five clinical and biochemical parameters were determined on 17 normal, male, laboratory-bred Bolivian squirrel monkeys. Parallel hematologic parameters were conducted. The correlation of biochemical and hematological

observations and the distribution characteristics, range, and standard error of the mean were determined, to establish baseline biochemical values for laboratory-bred squirrel monkeys and to present a correlative comparison between selected cellular elements and major blood electrolytes.

Blood variables in adult stumptail macaques (*Macaca arctoides*) living in a captive group; Annual variability. de Neef, K. J., Nieuwenhuijsen, K., Lammers, A. J. J. C., Degen, A. J. M. and Verbon, F. (Medical Research and Development Unit, Organon International B. V., P. O. B. 20, 5340 BH Oss, The Netherlands.) *Journal of Medical Primatology*, 1987, 16, 237-247.

.. Monthly blood samples were collected for more than two years from adult stumptail macaques living in a large captive group. The social organization, feeding pattern, and food composition were stable throughout the study period. No seasonal variability was observed for any of the 30 blood variables studied. It appeared that for each variable, within-animal variance was small relative to between-animal variance. A table of means and reference ranges is presented and discussed.

Renin angiotensin aldosterone axis, including aldosterone binding globulin and blood pressure in three species of nonhuman primates. Mavoungou, D., Nowaczynski, W., Cooper, R. W., Collet, J-Y. and Fung, K. (W. Nowaczynski, St. Paul's Hospital, 1081 Burrard Street, Vancouver, B. C. V6Z 1Y6 Canada. *Journal of Medical Primatology*, 1987, 16, 211-227.

.. Variables of renin-angiotensin-aldosterone axis with inclusion of protein binding to specific plasma globulin (ABG), plasma cortisol, and the blood pressure (BP) were measured in 24 chimpanzees, 4 gorillas, and 16 cynomolgus monkeys. ABG activity was readily detected in plasma from the primates. In chimpanzees and gorillas, all the variables under baseline conditions were similar to those in humans. In cynomolgus (*Macaca fascicularis*), both the ABG binding capacity for aldosterone and the diastolic or systolic BP were significantly higher than in chimpanzees and gorillas.

Reproduction

Early pregnancy diagnosis by the ultrasonographical device and observation of fetal growth in cynomolgus monkeys (*Macaca fascicularis*). Cho, F., Narita, H., Ono, T., and Honjo, S. (Tsukuba Primate Center for Medical Science, National Institute of Health, Hachimandai, Yatabe-machi, Tsukuba-gun, Ibaragi-ken, 305, Japan.) *Experimental Animals*, 1987, 36, 223-228. (Japanese, with English summary)

.. Usefulness of the ultrasonographical device for early diagnosis of pregnancy and for observation of fetal growth was examined in the cynomolgus monkey. Diagnosis was based on the detection of the gestational sac in the uterus. It was possible to judge conditions of fetal growth by measuring the size of the gestational sac and biparietal diameter.

Measurement of excreted steroids in *Macaca nemestrina*. Risler, L., Wasser, S. K. and Sackett, G. P. (Samuel K. Wasser, Dept. of Psychology, University of Washington, Seattle, WA 98195.) *American Journal of Primatology*, 1987, 12, 91-100.
... A practical method for the quantitative measurement of the estrogenic steroid estradiol-17beta in the feces of pigtailed macaques (*Macaca nemestrina*) is described. These methods provide a practical and accurate solution to the problem of collecting hormone data in field studies without the potential complications of capture in laboratory research.

Synchronization of ovarian cycles within and between social groups in golden lion tamarins (*Leontopithecus rosalia*). French, J. A. and Stribley, J. A. (Dept. of Psychology, University of Nebraska, Omaha, NE 68182.) *American Journal of Primatology*, 1987, 12, 469-478.

... The temporal association of ovarian events was examined in female golden lion tamarins living in the same or different social groups. Ovarian cyclicity was monitored by measuring the excretion of urinary estrogen metabolites. There was a high degree of synchronization in the occurrence of urinary estrogen peaks for females in different social groups (mean peak discrepancy = 2.1 days) and in females housed in the same social group (mean peak discrepancy = 1.3 days). Contrary to previous reports on callitrichid primates, daughters housed in their natal family group exhibited cyclic patterns of urinary estrogen excretion. These findings represent the first explicit demonstration of ovarian synchrony in a New World primate, and the tight coupling of ovarian cycles in female tamarins resembles the nature of menstrual synchrony in human females.

Serum chorionic gonadotropin levels determined by radioreceptorassay and early diagnosis of pregnancy in the cynomolgus monkey (*Macaca fascicularis*). Yoshida, T., Suzuki, K., Cho, F., and Honjo, S. (Tsukuba Primate Center for Medical Sciences, National Institute of Health, Hachimandai, Yatabe-machi, Tsukuba-gun Ibaragi-Ken 305, Japan.) *American Journal of Primatology*, 1987, 12, 101-106.

... The radioreceptorassay developed to determine serum luteinizing hormone level in the cynomolgus monkey was evaluated for its usefulness in early pregnancy diagnosis by the detection of serum chorionic gonadotropin (CG). Blood samples were collected at weekly intervals from the 1st to the 5th week after conception to determine changes in circulating levels of CG. In the pregnancy cases, serum CG levels increased to above 50 microg/ml in almost all animals. 95% of the pregnant cases were detected by 4 weeks after conception, and 5% were undetected as negative responses because their CG levels were low.

Birth intervals of *Cercopithecus* monkeys of the Kakamega Forest, Kenya. Cords, M. and Rowell, T. E. (Zoology Dept., University of California, Berkeley, CA 94720.) *Primates*, 1987, 28, 277-281.

... Data on interbirth intervals are reported for two forest-living guenons, *Cercopithecus mitis* and *C. ascanius*, from a western Kenyan site. Measured intervals for females whose first offspring survived varied from 24 to 54 months (median 47, $N = 10$) for *C. mitis*, and from 49 to 60 months (median 52, $N = 3$) for

C. ascanius. Intervals were shorter when the first of two offspring died. These results are supported by data on estimated intervals, in which the date of the first of two births was estimated, and incomplete intervals. Our measurements exceed previous estimates of interbirth intervals in wild populations and measured intervals of captive animals. Compared to closely related species inhabiting unpredictable and seasonal environments, these forest guenons breed very slowly indeed.

Acute effects of unilateral ovariectomy in the baboon *Papio cynocephalus*. Shaikh, A. A., Gbur, E. E. and Shaikh, S. A. (Dept. of Veterinary Physiology and Pharmacology, Texas A & M University, College Station, TX 77843-4466.) *Primates*, 1987, 28, 239-246.

...The purpose of this study was to determine if steroids secreted by one ovary affected the steroid secretion of the other ovary by direct transportation of the steroids via uterine blood vessels. Statistical analysis showed that change in utero-ovarian vein or uterine vein hormone levels on the contralateral side after removal of one ovary was not significant for any of the four hormones E&s'2, P, T, and A. There is no evidence to demonstrate cross circulation of steroids from one ovary to the other via direct vascular channels.

Serum LH, progesterone and estradiol-17beta levels throughout the ovarian cycle, during the early stage of pregnancy and after the parturition and the abortion in the common marmoset *Callithrix jacchus*. Torii, R., Koizumi, H., Tanioka, Y., Inaba, T. and Mori, J. (Institute for Experimental Animals, Shiga University of Medical Science, Seta, Ohtsu, Shiga, 520-21 Japan.) *Primates*, 1987, 28, 229-238.

...In the ovarian cycle of common marmosets, serum progesterone began to increase at two to three days after estradiol-17 beta or LH surge, attained a peak of 25-70 ng/ml and then declined to a level of under 2 ng/ml before the ensuing rise in estradiol-17 beta and LH. Serum estradiol-17 beta increased to 700-5,500 pg/ml during the luteal phase, synchronizing with progesterone. It is suggested that the corpus luteum secreted estradiol-17 beta as well as progesterone. The cycle length as determined from the interval between successive LH surges was approximately 28 days. During the luteal phase, the levels of progesterone and estradiol-17 beta were higher than in Old World monkeys and women, but there were no clinical symptoms due to excessive progesterone and estradiol-17 beta. This suggests that such unresponsiveness to progesterone and estradiol-17 beta in marmosets reflects the small amount of estradiol-17 beta receptor and presumably also the lower function of the post receptor system. Recovery of the post-partum ovarian cycle in two marmosets differed from that observed in Old World monkeys and women. This suggests that the suckling stimulus of newborns in the common marmoset does not cause any delay in recovery of the ovarian cycle. In three cases of abortion, the recovery of the ovarian cycle was almost the same as that in the case of normal parturition.

Sexual dimorphism and mating systems: Jumping to conclusions. Rowell, T. E. and Chism, J. (Dept. of Zoology, University of California, Berkeley, CA 94720.)

Human Evolution, 1986, 1, 215-219.

... Previous studies have suggested that there is a strong relationship between a high degree of aggressive competition among males for access to fertile females and large body and canine size in males. It has further been suggested that such a relationship among living primates can be used to infer the social organization of extinct primate species from the degree of sexual dimorphism exhibited. It is suggested, on the basis of observations of patas (*Erythrocebus patas*) and blue monkeys (*Cercopithecus mitis*), two species which had previously been characterized as having one-male "harem" group structures, that factors other than male-male competition (e.g., hybrid dimorphism predation) may also have influenced the degree of dimorphism in primates.

Determination of ovulation and pregnancy in the marmoset (*Callithrix jacchus*) by monitoring of urinary hydroxypregnanolone excretion. Heger, W. and Neubert, D. (Institut für Toxikologie und Embryopharmakologie, Freie Universität Berlin, Garystr. 5, D-1000, Berlin 33, FRG.) *Journal of Medical Primatology*, 1987, 16, 151-164.

... In *Callithrix jacchus* the urinary excretion of hydroxypregnanolone (5 α -pregnane-3 α , 7 α -diol-20-one) shows a luteal rise during the ovulatory cycle. This progesterone metabolite can therefore be used as an indication of ovulation, implantation, and subsequently for the persistence of the pregnancy. The excretion can be monitored by high performance thin-layer chromatography and postchromatographic derivatization after enzymatic hydrolysis of the conjugate. Profiles of urinary hydroxypregnanolone levels are presented and correlated with luteinizing hormone excretion. The method is noninvasive and therefore suited for long-term studies in these monkeys.

Testicular and serum testosterone variations in squirrel monkeys during seasonal cyclicity. Pasqualini, T., Colillas, O. and Rivarola, M. A. (Endocrinología, Hospital de Niños, Gallo 1330, 1425 Buenos Aires, Argentina.) *Journal of Andrology*, 1986, 7, 298-302.

... The seasonal testicular maturation of squirrel monkeys (*Saimiri sciureus*) was used as a model of maturational hormonal regulation of the testis. Testicular testosterone and serum testosterone concentrations were determined during the circannual variations of body weight and testicular volume. These data have been correlated with changes in the germinal epithelium.

... Testicular testosterone showed two annual elevations. The first peak coincided with the serum testosterone peak when body weight and testicular volume were high and the trophic response of the germinal epithelium was complete. The second peak was observed before the reinitiation of spermatogenesis. This was accompanied by a moderate increase in serum testosterone. The second peak of testicular testosterone, which has been reported to occur in the rat and in humans, might represent a local androgen need for initiation of spermatogenesis, while the first peak might represent the androgen need for full stimulation of spermatogenesis.

Reproduction in the crowned lemur (*Lemur coronatus*) in captivity. Kappeler, P. M. (Dept. of Zoology, Duke University, Durham, NC 27706.) *American Journal of Primatology*, 1987, 12, 497-503.

...Four pairs of captive crowned lemurs were studied during their annual breeding season to obtain baseline data on their reproductive biology for comparison with other *Lemur* species and to enhance their captive breeding success. Vaginal smears, testicular measurements, and records of the Duke University Primate Center provided the presented data. During a single breeding season, females cycled an average of three times, with an average cycle length of 34 days. Cycles were detected between November and March. Vaginal estrus and copulations were limited to one day per cycle. After 125 days of gestation females gave birth to one or two young. Both sexes attained sexual maturity at an age of about 20 months. Mean male testis size peaked in late December; at the same time, three of the females experienced their first estrus. Based on all available data, there was a significant positive correlation between cycle length and gestation length in the genus *Lemur*.

Supply

Conditioning and breeding facilities for the cynomolgus monkey (*Macaca fascicularis*) in the Philippines: A progress report on the SICONBREC project. Hobbs, K. R., Welshman, M. D., Nazareno, J. B. and Resuello, R. G. (Shamrock Farms (Great Britain) Ltd, Victoria House, Small Dole, Henfield, Sussex BN5 9XE, UK.) *Laboratory Animals*, 1987, 21, 131-137.

...Large-scale breeding of *Macaca fascicularis* in the country of origin is a way in which the demands of the research community can be met while the feral population of monkeys is safeguarded. This paper describes the development of the Simian Conservation, Breeding and Research Centre (SICONBREC) in the Philippines.

Taxonomy

The dentinoenamel junction in primates. Corruccini, R. S. (Dept. of Anthropology, Southern Illinois University, Carbondale, IL 62901.) *International Journal of Primatology*, 1987, 8, 99-114.

...Primate teeth were stripped of enamel after measurement, mapping, and anatomical observations on the original crown. The dentin surfaces thus revealed differ from the enamel surfaces in several respects and shed new light on such dental problem areas as the origin of the hypocone, the affinities of lorisooids and callitrichids, the monophyly of the anthropoid grade, and human affinities.

Reproductive strategies, body size, and encephalization in primate evolution. Shea, B. T. (Dept. of Anthropology, Northwestern University, Evanston, IL 60201.) *International Journal of Primatology*, 1987, 8, 139-156.

...The possible relationships among encephalization, precociality, small size, and arboreality are discussed, particularly in light of recent debates concerning the

validity of the superorder Archonta. This work emphasizes that we need to consider relative brain size as but one element in a complex synergistic network of morphological and life-history features.

Positional behavior of female Bornean orangutans (*Pongo pygmaeus*). Cant, J. G. H. (Dept. of Anatomy, School of Medicine, University of Puerto Rico, G. P. O. Box 5067, San Juan, PR 00936.) *American Journal of Primatology*, 1987, 12, 71-90.

... The orangutan is by far the largest mammal that travels in forest canopy, and a consideration of the ways that its positional behavior solves problems posed by habitat structure, particularly the tapering of branches and gaps between trees, indicates that suspensory capacities have been essential in permitting the evolution and maintenance of its great body size.

Multivariate sexing of the viscerocranium in *Cercopithecus pygerythrus*. Kieser, J. A. and Groeneveld, H. T. (Dept. of Anatomy, Witwatersrand University Medical School, Johannesburg, South Africa.) *Primates*, 1987, 28, 127-131.

... One hundred *C. pygerythrus* crania were subjected to canonical and stepwise discriminant analyses utilizing four viscerocranial measurements and two indices to determine specific characteristics useful in sexual distinction of skeletal material. The maxillo-alveolar length alone accounted for correct classification of 96.33% of males and 93.75% of females. Addition of the bimaxillary breadth enables 98.17% of males and 95.83% of females to be correctly assigned. From the observed contrast between univariate and multivariate analyses of the data set, it is concluded that both methods should routinely be combined in the evaluation of skeletal material.

The phylogenetic and taxonomic status of *Pan paniscus*: A chromosomal perspective. Stanyon, R., Chiarelli, B., Gottlieb, K. and Patton, W. H. (Institute of Anthropology, University of Pisa, 56100 Pisa, Italy.) *American Journal of Physical Anthropology*, 1986, 69, 489-498.

... In this report the phylogenetic position and taxonomic status of the pygmy chimpanzee is examined by a three-way comparison of the banded chromosomes of humans, *Pan troglodytes* and *P. paniscus*. The evaluation pays particular attention to distinguishing ancestral versus derived chromosomes in order to determine the direction of the chromosomal differences found between these three taxa. *P. paniscus* and *P. troglodytes* are shown to share a number of derived chromosomal changes indicative of a probable extensive period of common evolution after the divergence of the humans. The karyological evidence also demonstrates that the pygmy chimpanzee is most likely a valid species, and that it is also the most chromosomally specialized of the three taxa examined.

Therefore, from the chromosomal perspective, the pygmy chimpanzee is not the best model for the last common ancestor of both humans and African apes. The chromosomal data also suggest that all the African apes have evolved more from this last common ancestor than is generally considered.

Hominoid nasal region polymorphism and its phylogenetic significance.

Eckhardt, R. B. (Dept. of Anthropology and Graduate Program in Genetics, State University Park, PA 16802.) *Nature*, 1987, 328, 333-335.

...The morphology of the nasal bones and their articulations with adjoining frontal and maxillary bones have recently been reported in *Nature* and elsewhere to be diagnostic of hominoid taxa, and cladistic analysis based on these features has been used to assign two immature Plio-Pleistocene hominoids (AL 333-105 and Taung) to different lineages (*Paranthropus* and *Homo*, respectively). Because earlier studies had established that hominoid crania are highly variable intraspecifically, it seemed desirable to try to replicate the study reporting a consistently different pattern for each hominoid taxon. Results show extensive polymorphism in the nasal region within every taxon of extant pongids, including several rather clear examples, in extant *Pan troglodytes*, of that recently hypothesized to be a 'parathropine' pattern. These findings underscore the substantial risks inherent in cladistic analyses using very restricted character sets to assign individual specimens to particular taxa.

Type locality of *Hylobates concolor leucogenys*. Fooden, J. (Div. of Mammals, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.) *American Journal of Primatology*, 1987, 12, 107-110.

...Kloss (1929) restricted the type locality of the northern white-cheeked gibbon on the basis of two specimens that were collected at Muang Khi, Laos, not at Muang Pak-Lay, Laos, as conventionally assumed. The locality difference is zoogeographically important because Muang Khi is east of the Mekong River, within the known range of *H. c. leucogenys*, whereas Muang Pak-Lay is west of the river, outside the known range of the subspecies. The type-locality restriction is appropriately amended.

Uacaries, New World monkeys of the genus *Cacajao* (Cebidae, Platyrrhini): A preliminary taxonomic review with the description of a new subspecies.

Hershkovitz, P. (Field Museum of Natural History, Chicago, IL 60605.) *American Journal of Primatology*, 1987, 12, 1-53.

...The two known species of uacaries, inhabitants of the upper Amazonian region, are the black head *Cacajao melanocephalus* with subspecies *C. m. melanocephalus* Humboldt and *C. m. ouakary* Spix, and the larger bald head uacari *C. calvus* with subspecies *C. c. ucayalii* Thomas, *C. c. rubicundus* I. Geoffroy and Deville, *C. c. calvus* I. Geoffroy, and *C. c. novaesi* described as new. The species are described and compared and their geographic distribution plotted with those of their subspecies delimited. Sexual differences are outlined. A gazetteer identifies all locality records plotted by numbers on the geographic distribution maps.

Revision of the subspecies of *Australopithecus africanus* (Primates: Hominidae), including a new subspecies from the late Pliocene of Ethiopia. Ferguson, W. W. (Dept. of Zoology, Tel Aviv University, Ramat Aviv, 69 978, Tel Aviv, Israel.) *Primates*, 1987, 28, 258-265.

...The subspecies of *Australopithecus africanus* Dart, 1925 have been revised in a

morphological and statistical analysis. Four subspecific names were previously proposed, but only one was found to be valid. The subspecies *A. africanus transvaalensis* (Broom, 1936), from the Plio/Pleistocene of South Africa, cannot be sustained due to an insufficient sample, and is combined with the nominate race, *A. a. africanus*. The type of *A. africanus afarensis* Tobias, 1980 is a mistake in identification and not *A. africanus*, but a pongid. The population of *A. africanus* from the late Pliocene of Ethiopia does indeed represent a relatively small-toothed geographical race for which the name *A. africanus aethiopicus* was conditionally proposed; and the lectotype for it, A.L. 288-1, is not *A. africanus*, but the type of *Homo antiquus* Ferguson, 1984. The trinomial *aethiopicus* is thus unavailable for the Ethiopian race, which is redescribed as a new subspecies, *A. africanus miodentatus* n. ssp., and the mandible A.L. 266-1 is designated as the holotype.

The taxonomy of South American sakis, genus *Pithecia* (Cebidae, Platyrrhini): A preliminary report and critical review with the description of a new species and a new subspecies. Hershkovitz, P. (Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.) *American Journal of Primatology*, 1987, 12, 387-468.

. . . The species of *Pithecia* are arranged in the *Pithecia pithecia* group with *P. p. pithecia* and *P. p. chrysocephala*, and the *Pithecia monachus* group with *P. m. monachus*, *P. m. milleri*, *P. irrorata irrorata*, *P. i. vanzolinii* (new subspecies), *P. aequatorialis* (new species), and *P. albicans*. The discussion on nomenclature compares the usage of names by various authors for the different taxa. The species previously identified by Hershkovitz as *Pithecia monachus* proves to be the new species *P. aequatorialis*, whereas the sympatric species he called *P. hirsuta* Spix (1823) is the same as true *P. monachus* É. Geoffroy (1812). Details of sexual dimorphism in coloration and pelage patterns are described, and those of size are documented by summaries of weights and by measurements of external, cranial, dental, and skeletal characters for each sex of each taxon.

In many cases, the original source of references in this section has been the Current Primate References prepared by The Primate Information Center, Regional Primate Research Center, Regional Primate Research Center SJ-50, University of Washington, Seattle, WA 98195. Because of this excellent source of references, the present section is devoted primarily to presentation of abstracts of articles of practical or general interest. In most cases, abstracts are those of the authors.

* * *

Erratum

In Volume 26, number 3, of this *Newsletter*, the author's name, Woodrow W. Denham, was inadvertently left out of the review of *West Indian Green Monkeys: Problems in Historical Biogeography. Contributions to Primatology*, Volume 24.

* * *

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Dr. James Harper, Director of the Brown University Animal Care Facility, is now acting as an additional Consulting Editor on matters of laboratory animal science.

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