LABORATORY PRIMATE NEWSLETTER

Vol. 45, No. 4 October 2006

Published Quarterly by the Schrier Research Laboratory
Psychology Department, Brown University
Providence, Rhode Island
ISSN 0023-6861

POLICY STATEMENT

The *Laboratory Primate Newsletter* provides a central source of information about nonhuman primates and related matters to scientists who use these animals in their research and those whose work supports such research. The *Newsletter* (1) provides information on care and breeding of nonhuman primates for laboratory research, (2) disseminates general information and news about the world of primate research (such as announcements of meetings, research projects, sources of information, nomenclature changes), (3) helps meet the special research needs of individual investigators by publishing requests for research material or for information related to specific research problems, and (4) serves the cause of conservation of nonhuman primates by publishing information on that topic. As a rule, research articles or summaries accepted for the *Newsletter* have some practical implications or provide general information likely to be of interest to investigators in a variety of areas of primate research. However, special consideration will be given to articles containing data on primates not conveniently publishable elsewhere. General descriptions of current research projects on primates will also be welcome.

The *Newsletter* appears quarterly and is intended primarily for persons doing research with nonhuman primates. Back issues may be purchased for $10.00 each. We are no longer printing paper issues, except those we will send to subscribers who have paid in advance. We will not accept future subscriptions, unless subscribers are willing to pay $80/year within the U.S.; $100/year outside the U.S. (Please make checks payable to Brown University.) Readers with access to electronic mail may receive the nongraphic contents of each issue by sending the message **subscribe LPN-L your-own-name** to **listserv@listserv.brown.edu** (Send the message **subscribe LPN-PEF** to receive PDF files by e-mail; or the message **subscribe LPN-WARN** to receive a notice when a new issue is put on the Website.) Current and back issues of the *Newsletter* are available on the World Wide Web at <http://www.brown.edu/primate>. Persons who have absolutely no access to the Web, or to the electronic mailing, may ask to have paper copies sent to them.

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

PREPARATION OF ARTICLES FOR THE *NEWSLETTER.* – Articles, notes, and announcements may be submitted by mail, e-mail, or computer disk, but a printed copy of manuscripts of any length or complexity should *also* be sent by regular mail.. Articles in the References section should be referred to in the text by author(s) and date of publication, e.g., Smith (1960) or (Smith & Jones, 1962). Names of journals should be spelled out completely in the References section. Technical names of monkeys should be indicated at least once in each note and article. In general, to avoid inconsistencies within the *Newsletter*, the scientific names used will be those in *Mammal Species of The World: A Taxonomic and Geographic Reference*, 2nd Ed. D. E. Wilson & D. M. Reeder (Eds.). Washington, DC: Smithsonian Institution Press, 1993. For an introduction to and review of primate nomenclature see the chapter by Maryeva Terry in A. M. Schrier (Ed.), *Behavioral Primatology: Advances in Research and Theory* (Vol. 1). Hillsdale, NJ: Lawrence Erlbaum Associates, 1977.

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ACKNOWLEDGMENTS

The *Newsletter* is supported by Brown University

Cover photograph of a cotton-top tamarin (*Saguinus oedipus*) at Roger Williams Park Zoo, by Mark Abbott

Feeding Fruits and Vegetables to Nonhuman Primates Can Lead to Nutritional Deficiencies

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Introduction

Feeding laboratory nonhuman primates is mostly not simply the satisfaction of elementary nutritional needs. It is also often used as one of the most efficient forms of environmental enrichment for captive primates (Beirise & Reinhardt, 1992; Chamove & Anderson, 1989; Crockett et al., 1989; Evans et al., 1989; Heath et al., 1992; Meunier et al., 1989; Moazed & Wolff, 1988; Reinhardt, 1992, 1993a, 1993b). This is not surprising, since primates in nature normally spend a lot of time foraging – looking for and collecting many different types of plants, seeds, flowers, fruits, vegetables, and arthropods. Therefore, the food for laboratory primates often consists – besides pellets – of fruits, vegetables, and other edible items also useful for environmental enrichment.

As shown in this report, although very valuable at first impression, feeding of these additional food elements can increase the risk of imbalances in the diet. The supply of certain minerals, vitamins, and essential amino acids may be especially compromised. Consequently, nutrition-related illnesses may occur over the long term.

Material and Methods

History: The type of nutrition described here was established in the management of the African green monkey (*Chlorocebus aethiops*) colony at the Paul-Ehrlich-lnstitut (PEI) in order to provide "more fun" to otherwise stimulus-deprived caged nonhuman primates. The resulting diet was believed to be well balanced, since relatively large amounts of different nutritional elements were included (*Table 1*). Nevertheless, since the diet was not scientifically tested, some uncertainty remained about its balance. In a practical approach, pellets were offered in the morning without additional foodstuffs, in an attempt to force the monkeys to eat more of them. The pellets are proven to contain all essential ingredients for optimal nutrition of nonhuman primates.

The following nutrition-associated illnesses were observed in our colony during a 10-year period of observation: rickets, osteoporosis, diverticulosis, diarrhea correlated with invagination of the gut, and obesity associated with diabetes type II (non-insulin-dependent diabetes mellitus). These findings suggested nutritional imbalances, and led to the investigation described here.

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Diet: The usual nutrition of the monkeys at the PEI was carefully reported for three months. A model diet was calculated on the basis of the dietary components used during that time (*Table 1*).

Component	Amount g/day	Content % in OS	Content % in DM
ssniff Pri vegetarian	40.000	8.232	21.324
Banana, fresh with peel	121.000	24.902	13.963
Apple, fresh	71.000	14.612	6.344
Carrot, fresh	24.000	4.939	1.676
Tomato, fresh	10.000	2.058	0.343
Potato, boiled, with peel	42.000	8.644	5.518
Orange with peel	25.000	5.145	2.619
Green pepper, fresh	10.000	2.058	0.456
Cucumber	16.000	3.293	0.379
Lettuce	13.000	2.675	0.400
Radish, fresh	11.200	2.305	0.391
Raisins	2.500	0.515	1.247
Egg, boiled	5.000	1.029	0.757
Low fat curd (1% fat in DM)	4.000	0.823	0.443
Calcium citrate powder	0.080	0.016	0.046
Oat flakes	10.000	2.058	5.326
Peanuts, roasted	8.400	1.729	4.893
Grain mixture[1]	42.000	8.644	21.711
Wheat bread	8.000	1.646	2.964
Zwieback	6.700	1.379	3.628
Bread with calcium	15.000	3.087	5.557
Multisanostol®-juice[2]	1.000	0.206	0.006
Vigantol®-oil[3]	0.017	0.003	0.010
TOTAL	**485.897**	**100.00**	**100.00**

OS = Original substance; DM = Dry matter
[1]Grain mixture with shrimp (in their shells)
[2]Multisanostol®-juice (Altana, Hamburg, Germany) is a multivitamin drink with additional calcium
[3]Vigantol®-oil (Merck, Darmstadt, Germany) is a vitamin D_3-source.

Table 1: Composition of a typical daily ration for our African green monkeys. The nutrient contents of the above diet (*Table 2)* were calculated on the basis of the average nutrient concentrations in the individual components (from nutrition manuals), and the results were compared (*Table 3*) with recommendations for the nutrient supply of nonhuman primates obtained from the literature (National Research Council, 2003).

Briefly, the feeding procedure consisted of an ad libitum offer of pellets (ssniff, Primaten vegetarisch 10 mm; ssniff Spezialdiaten GmbH, Soest, Germany) in the morning between 7 and 8 a.m., and an offer of fruits and vegetables between 1 and 1:30 p.m. At 2 p.m. a handful of a grain/shrimp mixture (55% wheat, 5% barley, 27% maize, 3% sunflower kernels, 3% peas, 1% rapeseed, 3% oat and 2% shrimps) was thrown into the bedding of the cages for enrichment purposes.

Results

Table 2 shows the composition of the model diet. It should be noted that the exact composition of the diet may vary, depending, e.g., on the varieties, harvesting time, ripeness, cultivation region of the vegetables, etc.

Nutrient	Content in OS	Content in DM
Dry matter (%)	34.80	100.00
Crude protein (%)	5.20	14.92
Crude fat (%)	2.29	6.59
Crude fiber (%)	2.42	6.96
Crude ash (%)	1.57	4.53
Starch (%)	13.61	39.14
Sugar (%)	4.49	12.92
Lysine (%)	0.23	0.66
Methionine + Cystine (%)	0.18	0.51
Calcium (%)	0.15	0.43
Phosphorus	0.14	0.41
Ca : P ≈ 1	1.04	1.04
Sodium (%)	0.07	0.20
Magnesium (%)	0.05	0.15
Potassium (%)	0.40	1.16
Vitamin A (lU/kg)	1822	5240
Vitamin D (lU/kg)	1022	2938
Vitamin C (mg/kg)	343	986
ME (MJ/kg)	5.63	16.20

OS = Original substance; DM = Dry matter; ME = Metabolizable energy (Atwater); IU = International Units

Table 2: Contents of our model diet for African green monkeys.

The diet has a high energy density because of the high fat content. It has low calcium and phosphorus concentrations, and a Ca/P ratio close to 1.0.

If the actual contents of the diet fed to our African green monkeys are compared with the data published in the literature (National Research Council [NRC], 2003) the most obvious finding is that the amounts of calcium and phosphorus are very low in the diet (*Table 3*, light grey elements). In addition, some trace elements, particularly zinc, but also copper and selenium as well as vitamins A and E, might be scarce or deficient in the diet, especially for young growing animals and under certain conditions, such as stress or diseases (*Table 3*, light grey elements).

However, the supply of other vitamins (Vitamins D, C, K, B_1, B_2, B_6 and pantothenic acid) seems to be sufficient in the present diet. Although the dietary potassium concentration clearly exceeds the recommended value, this finding is normal for diets based on vegetable foods and is of no relevance for animal health, except in the case of very high sodium chloride concentrations (*Table 3*, dark grey elements).

Nutrient	Recommendation in DM	Actual diet in DM
Dry matter (%)	100	100
Crude protein (%)	15-22	15
Fat		
essential n-6 fat acids (%)	2	>2.1
essential n-3 fat acids (%)	0.5	>0.15
Minerals		
Calcium (%)	0.8	0.43
Phosphorus, total (%)	0.6	0.41
non-phytin-phosph. (%)	0.4	<0.35
Magnesium (%)	0.08	0.15
Sodium (%)	0.2	0.2
Potassium (%)	0.4	1.16
Trace elements		
Iron (mg/kg)	100	82
Manganese (mg/kg)	20	25
Zinc (mg/kg)	100	35
Copper (mg/kg)	20	10
Selenium (mg/kg)	0.3	0.2
Iodine (mg/kg)	0.35	0.6
Vitamins		
Vitamin A (lU/kg)	6,000 - 8,000	5,200
Vitamin D (mg/kg)	2,500	2,930
Vitamin E (mg/kg)	100	46
Vitamin C (mg/kg)	200	980
Vitamin K (mg/kg)	0.5	1.4
Thiamin (B_1) (mg/kg)	3	8
Riboflavin (B_2) (mg/kg)	4	8
Pyridoxine (B_6) (mg/kg)	4	9
Cobalamin (B_{12}) (pg/kg)	30	26
Pantothenic acid (mg/kg)	12	17
Niacin, available (mg/kg)	25	52 (total)
Folic acid (mg/kg)	4	2
Biotin (|jg/kg)	200	200
Choline (mg/kg)	750	960 (Choline-CI)

DM = Dry matter; IU = International units

Table 3: Comparison of the actual diet with the recommended dietary nutrient concentrations (NRC 2003). Light grey indicates deficiency, dark grey over-abundance, in actual diet.

On the other hand, the supply of some indispensable amino acids seems to be low, especially if the requirements of growing youngsters or lactating females are considered (see *Table 2)*. To our knowledge, up to now, there has been no systematic and openly accessible study on the requirements of nonhuman primates for individual amino acids. Therefore, in the case of the first limiting indispensable amino acid, lycine, the data presented here will be compared with the recommendations for the nutrient supply of humans and other mammals. For almost all fast growing animal species, an L-lysine (Lys) concentration of at least 5 g per 16 g dietary nitrogen (5 % Lys of the crude protein, [CP]) is recommended for optimum growth. According to the Food and Nutrition Board of the Institute of Medicine (IOM) recommendations, the diets for infants, children and adults should also contain around 5.1 g Lys/100 g CP (IOM, 2005). The National Research Council (NCR, 1995) set the Lys requirements of growing/reproductive and adult rats for maintenance metabolism at 0.92 % and 0.11 % in the diet, corresponding to 6.1 and 2.2 g Lys/100 g CP (15 and 5 % CP), respectively. Comparable requirement data (NRC, 1998) are also found for the fast growing piglet (>5.5 g Lys/100 g CP; 1.15 – 1.35 % Lys in the diet), fattening (4.5 – 5.3 g Lys/100 g CP; 0.60 – 0.95 % Lys in the diet), and adult pig (4.3 – 4.6 g Lys/100 g CP; 0.52 – 0.60 % Lys in the diet). Consequently, the actual lysine supply of the primates (0.66 % in DM; 4.4 g/100 g CP) has to be assessed as inadequate, at least for youngsters.

The requirements of nonhuman primates for sulphur amino acids (SAA = Methionine + Cystine) cannot be compared with that of humans, because of the hairy coat of nonhuman primates, which contains high amounts of SAA, resulting in higher requirements for these amino acids. The SAA requirement of the growing and adult rat is set to 0.98% and 0.23% in the diet or 6.5 and 4.6 g Met+Cys/100 g CP, respectively (NRC 1995). Furthermore, growing kittens need around 0.75% SAA in their diet or 3.1 g SAA/100 g CP (NRC, 1986). According to these data, the concentration of SAA in the actual monkey ration is also marginally low.

Discussion

In nature, nonhuman primates usually spend a lot of time foraging. This is totally different in a laboratory setting where nonhuman primates normally find their food easily available. Therefore, efforts have been made to stimulate foraging behavior in the laboratory setting. For this purpose, pellets are usually not as suitable as fruits or vegetables. Consequently, there is a trend to add these foods to the regular pelleted diet.

However, as shown in this report, this procedure can have undesirable side-effects. Since the pellets are not as tasty as fresh natural foods, the primates tend to avoid well-balanced pellets and – instead – prefer the fruits and vegetables. This is even the case if the pellets are flavored. However, the resulting food intake is no longer well-balanced. Even if the colony management is aware of this fact, the only pellets currently commercially available are designed to be used as exclusive foods. In other words, pellets meant to be used as a corrective additive to fruits and vegetables are only available on special request. These pellets are extraordinarily expensive compared to standard pellets.

When calculating the intake of certain ingredients in caged nonhuman primates, it must be taken into consideration that a certain percentage of the food that had been offered for consumption is lost since monkeys tend to throw a lot of food particles into the bedding. Some of these might be picked up again later by the monkeys themselves, or might be thrown away during the daily cleaning. It is therefore essential to calculate carefully the amount of food lost in the cage.

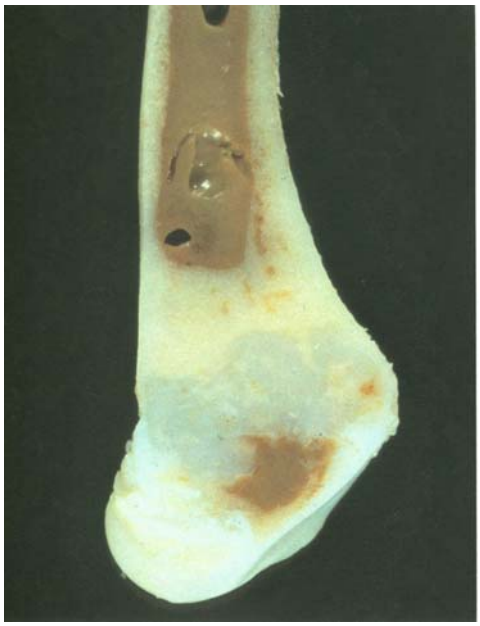

Figure 1: Rickets: Disturbed epiphyseal growth with irregularly occurring cartilage.

As shown in the "Results" section, our "natural" diet is insufficient in terms of the minerals calcium and phosphorus. This was presumed before the results of this study were known, since about 7% of the youngsters in the colony displayed slight to clear signs of rickets (*Figure 1*). Although rickets may have a genetic background as well, the occurrence of bone disease is always a hint to examine the diet. The severity of the calcium deficiency is aggravated in our case by the relatively high dietary vitamin D, which may support the resorption of bone and the calcium release from bone. Although other factors might contribute to the occurrence of osteoporosis, the amount of available calcium in the diet is the most critical element in the development of this disease as well.

Diverticulosis in humans is known to be the result of a fiber-deficient diet. Although the actual diet seems to contain sufficient amounts of crude fiber, seasonal variation in the nutrient contents of the vegetable foods or selection of more palatable parts of the vegetables, i.e. rejecting peels, by the individual animal may lead to an inadequate supply of crude fiber.

There are various reasons for the occurrence of diarrhea and enteritis in nonhuman primates: e.g., infections, toxins, or an inappropriate diet. No matter what the original reason, enteritis is always associated with an increase in the motility of the gut muscles, which increases the risk of invaginations of the gut. Prolapses of the gut through the anus are clinical correlates of this development. These clinical signs have been detected in our colony.

In addition, feeding a high calorie diet, along with lack of locomotion and foraging – as often occurs in caged primates – leads to obesity. Obesity is one of the most mentioned risk factors for the development of diabetes type II (non-insulin-dependent diabetes mellitus). This occurs, not only in humans, but also in our colony of nonhuman primates.

Although there was a marginal supply or a shortage of some trace elements (e.g. zinc) and vitamins A and E in the daily ration of our African green monkey colony, no clinically evident findings could be attributed to it.

In conclusion, our experience with health problems in our monkey colony, along with the results of the calculations for the actual nutrients supplied by our daily ration, has led us to encourage an increased consumption of "normal" pellets by our nonhuman primates. Fruits and vegetables are no longer offered more than twice a week. This increases the amount of well-balanced food in the diet, decreasing the risks of imbalances. In addition, this avoids the need to produce special pellets as food additives for fruit- and vegetable-eating primates. However, it still allows the use of natural food as environmental enrichment. Other possible solutions, e.g. the intensive use of calcium citrate-powder (dispersed over the fruits) were not successful in our setting. In addition, this solution can only influence the calcium part of the deficiencies noted (if no other changes in the diet are implemented simultaneously). On the other hand, we still wish to avoid exclusive pellet feeding, because of the enrichment benefits of natural food. Moreover, for the future, it would be desirable if monkey pellets enriched with calcium (and phosphorus) and vitamins, as well as some trace elements and indispensable amino acids (e.g. lysine, methionine), were available as standard complementary diets on the market, which would allow daily feeding of vegetables without health risks for the animals.

References

Beirise, J., & Reinhardt, V. (1992). Three inexpensive environmental enrichment options for group-housed *Macaca mulatta*. *Laboratory Primate Newsletter, 31*[1], 7-8.

Chamove, A. S., & Anderson, J. R. (1989). Examining environmental enrichment. In: E. F. Segal (Ed.), *Housing, care and psychological well-being of captive and laboratory primates* (pp. 183-202). Park Ridge, NJ: Noyes Publications.

Crockett, C., Bielitzki, J., Carey, A., & Velez, A. (1989). Kong toys as enrichment devices for singly caged macaques. *Laboratory Primate Newsletter, 28*[2], 21-22.

Evans, H. L., Taylor, J. D., Ernst, J., & Graefe, J. F. (1989). Methods to evaluate the well-being of laboratory primates: Comparison of macaques and tamarins. *Laboratory Animal Science, 39*, 318-323.

Heath, S., Shimoji, M., Tumanguil, J., & Crockett, C. (1992). Peanut puzzle solvers quickly demonstrate aptitude. *Laboratory Primate Newsletter, 31*[1], 12-13.

Institute of Medicine (2005). *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids* (macronutrients). Food and Nutrition Board of the National Academies. Washington, DC: National Academy Press.

Meunier, L. D., Duktig, J. T., &. Landi, M. S. (1989). Modification of stereotypic behavior in rhesus monkeys using videotapes, puzzle feeders and foraging boxes. *Laboratory Animal Science, 39*, 479.

Moazed, T. C., & Wolff, A. V. (1988). The raisin board as an environmental enrichment tool for laboratory primates. *Laboratory Primate Newsletter, 27*[1], 16.

National Research Council (1986). *Nutrient Requirements of Cats. II. Series: Nutrient requirements of domestic animals. Revised Edition.* Washington, DC: National Academy Press.

National Research Council (1995). *Nutrient Requirements of Laboratory Animals. 4th Revised Edition*. Washington, DC: National Academy Press.

National Research Council (1998). *Nutrient Requirements of Swine. 10th Revised Edition*. Washington, DC: National Academy Press.

National Research Council (2003). *Nutrient requirements of nonhuman primates. 2nd Revised Edition*. Washington, DC: National Academy Press.

Reinhardt, V. (1992). Foraging for commercial chow. *Laboratory Primate Newsletter, 31*[2], 10.

Reinhardt, V. (1993a). Using the mesh ceiling as a food puzzle to encourage foraging behavior in caged rhesus macaques (*Macaca mulatta*). *Animal Welfare, 2*, 165-172.

Reinhardt, V. (1993b). Enticing nonhuman primates to forage for their standard biscuit ration. *Zoo Biology, 12*, 307-312.

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Resources Wanted and Available

What Investigators Need to Know…

The Office of Laboratory Animal Welfare (OLAW) has created a brochure intended to communicate to investigators their responsibilities under Public Health Service (PHS) Grants Policy and PHS Policy on Humane Care and Use of Laboratory Animals. *What Investigators Need to Know About the Use of Animals* provides a succinct resource for investigators to quickly grasp the main expectations and requirements when using animals in research supported by the PHS. The brochure may be accessed at <grants.nih.gov/grants/olaw/InvestigatorsNeed2Know.pdf>. OLAW will provide institutions with enough copies to disseminate to all of their investigators who work with animals. Send requests, along with the number of copies needed, to <*olaw@od.nih.gov*>, and please be sure to provide your complete mailing address.

OLAW has also posted, at <grants.nih.gov/grants/olaw/faqs.htm>, a series of Frequently Asked Questions (FAQs) that supersedes guidance previously published. The FAQs provide guidance on topics not previously addressed by OLAW, including the Freedom of Information Act, post approval monitoring, HVAC malfunctions and failures, and rodent cage density.

New Primate Behavior Photos

Annie and Viktor Reinhardt have updated the photos on their Laboratory Animal Refinement & Enrichment Forum (LAREF) site, <www.awionline.org/lab_animals/LAREF/LAREFphotos.html>. There are new photos on foraging and play behavior in long-tailed macaques, and a series of photos from Viktor's archive on rhesus body language and expression of feelings. Feel free to send photos to <*annierei@snowcrest.net*> for posting.

New Report on the Animal Welfare Act

The Library of Congress Congressional Research Service (CRS) has issued an updated report which is a synopsis the Animal Welfare Act (AWA). In addition to being a good summary of the Act's key provisions and legislative history, the report provides background on pieces of legislation that have sought to amend the AWA over the years, including currently pending legislation such as the Pet Safety and Protection Act and the Pet Animal Welfare Statute. A copy of CRS's report can be downloaded by clicking <www.nabr.org/pdf/CRSreport.pdf> or by visiting the NABR Website at <www.nabr.org>. – *From an August 17 Foundation for Biomedical Research* "Update"

NHP Caging Systems Available

Lab4less, at <www.Lab4less.com>, has a large variety of new and used surplus nonhuman primate caging available. Here's a partial listing:

- Marmoset cage rack, two levels of four cages each, auto-water, perches and nest boxes, one community rack.
- Four small primate exercise cages, auto-water, removable floor.
- 10 Squirrel Monkey racks, one cage over one (1x1), new.
- 13 Baboon cages, aluminum, 9-sq.-ft. interior, pull-back.
- 19 Baboon cages, aluminum, auto-water, squeeze-back.
- Two Allentown FAL5025 macaque quad racks.
- 36 Lab Products group 3 macaque cage racks, individual and racks.
- 11 Porter Matthews single NHP cages, group 3, aluminum, squeeze-back, guillotine door.
- Four Labcare Caging single group 4 cages, aluminum, auto-water, squeeze-back.
- 40 Group 3 NHP cage racks, 1x1, manual water.
- 25 Group 3 NHP cage racks, two cages over two (2x2), squeeze-back, guillotine, auto-water, like new.
- Four Group 3 NHP cage racks, 2x2, squeeze-back, perch, guillotine door, auto-water.
- 18 Harford Metal Products, group 3 racks, 2x2, squeeze-back, auto-water.
- Five Hoeltge, group 3 tandem NHP cages, 1x1, squeeze-back, manual water, perches.
- Miscellaneous quad group 3 NHP racks in different configurations.

Lab4less also has autoclaves, cage and rack washers, surgery and procedure equipment, anesthesia equipment, etc. If you don't see what you are looking for, contact Ian Gardner [619-222-4940; e-mail: *igardner@lab4less.com*].

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Meeting Announcements

The Yerkes National Primate Research Center is hosting the **24th Annual Symposium on Nonhuman Primate Models for AIDS,** October 4-7, 2006, in Atlanta, Georgia**.** For more information and to register, visit <guest.cvent.com/EVENTS/Info/Summary.aspx?e=38ab0d87-2ebc-433f-b933-e95637cce1d0>.

The **Latin-American Affairs Committee (LAAC) of the Animal Behavior Society** has organized a fall meeting in Xalapa, Mexico, October 8-12, 2006, in order to promote participation of animal behaviorists from the whole continent in the Society. The meeting is an attempt to bring the society closer to the rest of the continent, and to attract attendance from both sides of the U.S.–Mexican border. The format is a small meeting, similar to regional ABS meetings (50-100 people), with lecture sessions and a poster session. The host institution will be the Instituto de Ecología, A.C., co-host of the 2004 Oaxaca meeting, located in the colonial city of Xalapa. See <www.ecologia.edu.mx/laabs> for complete information.

The Student Animal Legal Defense Fund (SALDF) at Lewis & Clark Law School, in Portland, Oregon, devoted to enhancing the welfare and legal status of all nonhuman animals, sponsors and organizes an annual **Animal Law Conference** each fall with the assistance of the National Center for Animal Law. This year's conference will be October 13-15. See <www.lclark.edu/org/saldf/conference.html>.

The **Belgian Council for Laboratory Animal Science** will hold its annual **Symposium** on November 16, 2006, in Louvain-la-Neuve. The title is: "How to Apply the 3 Rs in Our Daily Work", and the working languages are Dutch and French. More information (program, registration form, contacts, etc.) can be found on the Website: <www.alphavisa.com/bclas2006>.

The **2006 American College of Veterinary Pathologists** and **American Society for Veterinary Clinical Pathology Concurrent Annual Meetings** will be held on December 2-6 at the Hilton El Conquistador Golf and Tennis Resort in Tucson, Arizona. See <www.acvp.org/meeting>.

The **2006 Scientists Center for Animal Welfare (SCAW) Conference** will be held December 4-5 in San Antonio, Texas. The topic will be "Addressing Current Animal Research and IACUC Issues". See <www.scaw.com>.

The **8th International Conference on Environmental Enrichment** will be held August 5-10, 2007, hosted by the Schoenbrunn Zoo, Vienna, Austria. The theme is "Enrichment – Key for Successful Animal Management". Presenters are from a broad variety of backgrounds, from zoos and biological, agricultural, and laboratory facilities, and work with wild animal species, domestic animals, and pets. Topics include reports and presentations about development of, success with, and further experiences with enrichment issues. The preliminary program, call for papers, and registration information are available at <www.zoovienna.at/icee2007>.

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Awards Granted

IPS Student Oral and Poster Presentation Awards

"The International Primatological Society's Education Committee is pleased to announce the winners from our second student awards competition, held during the IPS Congress in Entebbe, Uganda. The competition resulted in many outstanding oral and poster presentations by our student members. With a total of 70 submissions the competition was very competitive (so to speak)!

"Best Student Oral Presentation: Eric Arnhem, Free University of Brussels: 'Comparative analysis of the impact of selective logging on spatial distribution of great apes in an active logging concession of southeastern Cameroon'.

"Honorable Mention Oral Presentations: Katherine Cronin, University of Wisconsin: 'The Effect of unequal reward distribution on cooperative problem solving in cotton-top tamarins (*Saguinus oedipus*)'; and Luke Dollar, Duke University: 'Primates and other prey items in the seasonal diet of *Cryptoprocta ferox* in Ankarafantsika National Park, Madagascar'.

"The Best Student Poster Presentation was by Zhang Peng, Primate Research Institute, Kyoto University: 'Eye colour of Japanese monkeys (*Macaca fuscata*)'."

Anne Savage, IPS Vice-President for Education, and the Education Committee extend their sincere thanks to the judges who participated in the review of the oral and poster presentations. "We recognize the significant contributions of G. Anzenberger, T. Bettinger, J. Bielitzki, C. Fetchell, P. Kaeppler, K. Leighty, E. Lonsdorf, L. Marsh, C. McCann, M. Myers, J. Oates, J. Ratsimbazafy, R. Rylands, G. Sackett, T. Struhsaker, S. Schapiro, and J. Setchell."

* * *

Workshop Announcements

IACUC 101 and 102 Plus Workshops in Hawaii

On Wednesday, November 8, and Thursday, November 9, 2006, in Honolulu, Hawaii, the NIH Office of Laboratory Animal Welfare (OLAW), the Henry M. Jackson Foundation, the University of Hawaii, and Tripler Army Medical Center will co-sponsor two days of IACUC training at the Waikiki Marriott Hotel. The first day is a traditional IACUC 101 course, which is a full-day didactic and interactive training course that provides a basic, yet comprehensive, overview of the laws, regulations, and policies that govern the humane care and use of laboratory animals, with examples and possible approaches for successful and effective administration. The second day is a special IACUC 201 course, which is a highly interactive program that takes the fundamentals of IACUC 101 and applies them to the process and mechanisms of ensuring compliance with a mock IACUC in the afternoon session to address complex scenarios.

Program information is posted at <www.hjf.org/events>. Click on "View All" on the left side of the screen, scroll down to the "IACUC 101/201 PLUS" event, and click on "More Information" for specific information including agenda, travel and accommodations information, and an online registration form. You may also contact Margaret C. Quinlan, Animal Welfare Program Specialist, OLAR, NIH, 6705 Rockledge Dr., Suite 360, Bethesda, MD 20892-7982 [301-402-4325; fax: 301-402-2803; e-mail: *quinlanm@od.nih.gov*].

Old World Monkey Behavioral Management

The Old World Monkey Taxon Advisory Group (TAG) is planning a 3.5 day workshop that will present a wide array of topics relating to the behavior and management of Old World monkeys (OWMs), with particular emphasis on techniques that enhance social housing opportunities. It is designed for those who care for and manage OWMs, including curators, supervisors, keepers, and veterinarians. This workshop will be a comprehensive examination of the behavioral management approach to caring for captive primates, focusing on positive reinforcement training, OWM behavior, the use of psychotropic drug therapy, hormonal treatments, and alternative therapies to manage behavior, address behavioral problems, and reduce risks associated with social housing and introductions of OWMs. Workshop format will include lectures, discussions, small group projects, and demonstrations. Skills taught are directly related to enhancing socialization and reducing the associated risks, and improving the overall ability to maintain more appropriate social groupings of OWMs.

The workshop, March 19-22, 2007, will be hosted by the Saint Louis Zoo. Instructors include: TAG members who are experts in OWM behavior and management, and experts in the fields of contraception, psychotropic therapies, and alternative therapies.

For information, contact Colleen McCann, OWM TAG Chair [e-mail: *cmccann@wcs.org*]; or Margaret Whittaker, OWMTAG Behavioral Management and Training Advisor [e-mail: *indu22@earthlink.net*]. Please note the Old World Monkey TAG meeting will take place immediately following the workshop, on March 22-23, 2007.

* * *

Research and Educational Opportunities

Postdoctoral Training in Biomedical Research

The Division of Comparative Medicine at the Massachusetts Institute of Technology is seeking veterinarians for its NIH-funded training program in biomedical research. The program includes three and a half years of research and clinical training as well as academic classes. The clinical experience and didactic training in laboratory animal medicine, laboratory animal pathology, and research prepare candidates for the ACLAM board examinations and careers in biomedical research. Clinical training will entail daily rounds in the Division's state-of-the-art AAALAC-approved animal facilities that include extensive surgical resources and fully equipped transgenic laboratories. Training activities also occur in the Division's research and diagnostic laboratories, at Harvard's Regional Primate Center, and at other biomedical research laboratories. Candidates have the option of pursuing a master's degree or doctorate through MIT's Division of Biological Engineering. For details regarding the program, see <web.mit.edu/comp-med/postdoc>.

Requirements: DVM from an AVMA-accredited institution, strong interest in research, and U.S. citizenship or permanent residency. Interested candidates should send a cover letter, CV, and three letters of support to: Dr. James G. Fox, MIT Division of Comparative Medicine, 16-825, 77 Massachusetts Ave, Cambridge, MA 02139 [e-mail: *jgfox@mit.edu*]. MIT is an Affirmative Action/Equal Opportunity Employer.

Positions Available

Psychobiologist – UC-Davis

"The Department of Psychology at the University of California, Davis, invites applications for a tenure-track position in Psychobiology, to begin in July, 2007. The appointment will be at the Assistant Professor level. We are interested in candidates who are working on mechanisms of behavior involving neurobiological and/or genetic approaches to psychological processes such as learning, motivation, or emotion. We are especially interested in candidates who study these mechanisms at the tissue, cellular, and/or molecular levels but who also have sophisticated approaches to behavior, which can include comparative or evolutionary approaches. Candidates must have a PhD and also have a demonstrated record or evident potential to teach undergraduate and graduate courses in psychobiology, to supervise dissertation research, and to obtain external funding.

"Interested applicants should submit a CV, statements of research and teaching interests, representative reprints and/or preprints, and at least three letters of recommendation. Review of applications will commence on November 1, 2006, and continue until the position is filled. Send materials to: Psychobiologist Search Committee, Dept of Psychology, One Shields Ave, University of California, Davis, CA 95616-8686.

"For information, contact the Search Committee Chair, Dr. John Capitanio, at the above address or by e-mail: <*jpcapitanio@ucdavis.edu*>. This position is subject to final administrative approval.

"To learn more about the rapidly expanding programs of research in psychobiology at UC-Davis, visit our Web page at <psychology.ucdavis.edu/psychareas/?AreaID=3&link=25>. UC-Davis and the Department of Psychology are interested in candidates who are committed to the highest standards of scholarship and professional activities, and to the development of a campus climate that supports equality and diversity. The University of California is an affirmative action/equal opportunity employer."

Clinical Veterinarian – New Mexico

Lovelace Respiratory Research Institute, one of the nation's largest independent, nonprofit biomedical research organizations, and the nation's only such organization wholly dedicated to basic research on respiratory health problems, is seeking a clinical veterinarian with a DVM degree, licensed in at least one state. This position also requires training or experience with laboratory animal species and familiarity with applicable federal requirements. Experience with good laboratory practices, nonhuman primates, and Animal Biosafety Level 3 is preferred. You will be responsible for the medical care of laboratory animals including diagnosis and treatment of disease, preventive medicine, and health monitoring.

"We offer competitive salaries and excellent benefits. Candidates should send a resume, noting job number 'S4506', to LRRI Human Resources, 2425 Ridgecrest Dr. SE, Albuquerque, New Mexico 87108 [fax: 505-348-4976; e-mail: *www.hrmail@lrri.org*]. You are encouraged to visit <www.LRRI.ORG> for additional employment opportunities and information. We are an Equal Opportunity/Affirmative Action Employer."

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Information Requested or Available

More Interesting Websites

- Australasian Zoo Keeping: <www.australasianzookeeping.org>
- "Establishment of a Zoological Browse Data Base", by T. L. Lehr, M. M. Moore, S. Williams, and N. A. Irlbeck: <www.nagonline.net/Proceedings/NAG1997/Establishment%20of%20a%20Zoological%20Browse.pdf>
- Focusing on the trade, abuse and treatment of orangutans throughout the world: <www.born-to-be-wild.org>
- Indonesian Primatological Association: <www.apapi.org>
- Links to Websites related to conservation of Asian lorises and African pottos: <www.loris-conservation.org>
- *NIH Extramural Nexus*, July, 2006: <grants.nih.gov/grants/partners/0706Nexus.htm>
- *PaleoAnthropology*, official publication of the PaleoAnthropology Society: <www.paleoanthro.org/journal>
- *Primates In Medical Research,* a report by the Medical Research Council (U.K.): <www.mrc.ac.uk/primates_medical_research.pdf>
- Published Laboratory Animal Refinement and Enrichment Forum (LAREF) discussions: <www.awionline.org/lab_animals/laref-discussions.htm>
- What Investigators Need to Know about the Use of Animals: <grants.nih.gov/grants/olaw/InvestigatorsNeed2Know.pdf>

News Briefs

Brown Is Acting Director of OLAW

The National Institute of Health's Office of Laboratory Animal Welfare (OLAW) announced that beginning July 24, 2006, Patricia A. Brown, VMD, was temporarily assigned to the position of Acting Director, OLAW. Dr. Brown received her BSc degree in Animal Science (1974) from Pennsylvania State University and her veterinary degree (1978) from the University of Pennsylvania. She served in the U.S. Air Force for eight years and while on active duty earned a MSc in Laboratory Animal Medicine from the M. S. Hershey Medical Center, Pennsylvania State University, Hershey, Pennsylvania. She joined the U.S. Public Health Service in 1986 and has served in a variety of positions at the National Institutes of Health within the Veterinary Resources Branch, the National Cancer Institute, and the Office of Animal Care and Use. Since 2001 she has been the Deputy Director in the Office of Animal Care and Use, Office of Intramural Research, Office of the Director, NIH. Dr. Brown is a diplomate of the American College of Laboratory Animal Medicine (ACLAM), has served on the Board of Directors of ACLAM, is a past president of the American Society of Laboratory Animal Practitioners (ASLAP), and currently serves on the Board of Trustees of AAALAC International representing ASLAP.

Tacugama Chimpanzee Sanctuary Update

Heavy rains have slowed efforts to bring in the remaining chimpanzees that escaped as a group of 27 from the Tacugama Chimpanzee Sanctuary in Sierra Leone on April 23, but one adolescent was returned in late June, leaving five chimpanzees still on the loose. According to Tacugama staff, the remaining chimpanzees have ranged far into the Western Forest Reserve during the two-plus months of their escape, but have since returned quite close to the main compound at Tacugama. The escaped chimpanzees call regularly to the ones in the enclosures, causing a great deal of excitement and vocalization. – *a July 23 report from the Pan African Sanctuary Alliance*

Uganda Hikes Park Fees for Foreign Visitors

Beginning August 1, tourists pay more to enter Uganda's national parks as the country addresses the rising costs of managing wildlife resources and promoting tourism. The new fees apply to the country's 10 national parks and 12 wildlife reserves and will only apply to foreigners, as a move to boost domestic tourism.

One-day park entry fees for foreign visitors have increased to $25 from $20; a two-day pass will cost $35 and three days or more will cost $50. A single gorilla-tracking permit for foreign tourists will cost $375, up from $360, which is the same as that charged by neighboring Rwanda and the Democratic Republic of Congo. East African residents wishing to track Uganda's mountain gorillas will now pay $355, up from $340, while Ugandans will continue paying $54.

Gorilla tracking in Uganda has become the single most popular activity for foreign tourists, with permits selling out up to two years in advance. Despite a steady growth in domestic tourism, few Ugandans have shown any interest in gorilla tracking. Gorilla tracking is done inside the Bwindi Impenetrable Forest National Park. – *from* The East African *(Nairobi), July 31*

Scientist Driven from Primate Research

The Animal Liberation Front (ALF) recently took "credit" for driving a UCLA scientist to abandon his vision research with nonhuman primates, which was funded by a 10-year grant from NIH's National Eye Institute. The researcher, his wife, and their two children were terrorized at their California home for months. On August 7, UCLA issued a press statement condemning the illegal terrorist activities, and pledged to continue to fulfill its commitment to improving human health and the quality of life through humane animal research. The University also stated that they are continuing to work with the FBI on its investigation into terrorist acts directed at University researchers, which includes an investigation into the recent attempted firebombing of another UCLA scientist with a Molotov cocktail. – *From an August 17 Foundation for Biomedical Research* "Update"

Gibbon Genome to Be Sequenced

The National Human Genome Research Institute (NHGRI), one of the National Institutes of Health (NIH), has announced several new sequencing targets including the Northern white-cheeked gibbon (*Nomascus leucogenys*), setting the stage for completing a quest to sequence the genome of at least one nonhuman primate genome from each of the major positions along the evolutionary primate tree and making available an essential resource for researchers unraveling the genetic factors involved in human health and disease. Comparing the genomes of other species to humans is an exceptionally powerful tool to help researchers understand the working parts of the human genome in both health and illness.

NHGRI's Large-Scale Sequencing Research Network and their international partners have already sequenced – or have been approved to sequence – at high-density coverage the genomes of several nonhuman primates including the chimpanzee (*Pan troglodytes*), rhesus macaque (*Macaca mulatta*), orangutan (*Pongo pygmaeus*), marmoset (*Callithrix jacchus*), and gorilla (*Gorilla gorilla*).

"The gibbon genome sequence will provide researchers with crucial information when comparing it to the

human genome sequence and other primate genomes, shedding light on molecular mechanisms implicated in human health and disease – from infectious diseases and neurological disorders to mental illness and cancer," said NHGRI Director Francis S. Collins, M.D., Ph.D.

The gibbon genome is unique because it carries an extraordinary high number of chromosome rearrangements, even when compared to other primates. These rearrangements occur when small or large segments of a chromosome become detached and reattach to the same chromosome or another chromosome. Such chromosomal rearrangements can wreak havoc on a cell, and can contribute to birth defects or cancer in humans. The gibbon genome will also help scientists better understand rearrangements called segmental duplications, which are large, almost identical copies of DNA present in at least two locations in the human genome. A number of diseases are known to be associated with mutations in segmental duplicated regions, including a form of mental retardation and other neurological and birth defects.

The NHGRI's Division of Extramural Research supports grants for research and for training and career development at sites nationwide. Additional information about NHGRI can be found at its Website, <www.genome.gov>. – *NIH News, July 19, 2006*

William Russell, Three Rs Pioneer

William M. S. Russell, professor and co-author of a book that advanced the Three Rs concept in animal research, died July 27 in Reading, England, at the age of 81. Russell was described as a brilliant zoologist, psychologist, and classics scholar.

In "The Principles of Humane Experimental Technique", first published in 1959, Russell and Rex L. Burch described the "Three Rs" approach to animal research: Replacing experiments involving animals with in vitro models like tissue and cell culture where possible, Reducing the number of animals used in experiments to obtain statistically relevant data, and Refining procedures to minimize pain and distress in experimental animals and provide for their well-being.

The Three Rs are now being practiced in laboratories throughout the world and have been incorporated in animal care legislation in the United States and the European Union. – *from an Americans for Medical Progress* News Service Digest, *August 10, 2006*

Smuggled Gorillas Will Go Back to Cameroon

South Africa's National Zoo has said that four gorillas in its care would be returned to Cameroon, ending a long running dispute that had captured the attention of animal welfare activists. The final decision to send the apes to Cameroon was made by the government of Malaysia under a complex diplomatic arrangement which gave it ultimate authority over the animals.

"The National Zoological Gardens of South Africa was recently informed by the Government of Malaysia of its decision to relocate the four infant gorillas ... to the Limbe Animal Orphanage in the Cameroon," the Zoo said.

Cameroon had repeatedly called on South Africa to return the animals, dubbed the "Taiping Four", named after the Malaysian zoo where they appeared after being smuggled out of Cameroon via Nigeria. Amid the outcry, Malaysia agreed to send the lowland gorillas back to their home continent, but not their homeland. They arrived in South Africa in 2004. – *Reuters, September 4, 2006.*

AIDS Vaccine Moves to Clinical Trials

A new multiprotein AIDS vaccine will be evaluated in humans for the first time, after its remarkable success in protecting monkeys from the disease. In studies conducted at the NCRR-funded Yerkes National Primate Research Center, the vaccine protected 96 percent of monkeys from developing AIDS for more than three years, providing better and longer protection than any other AIDS vaccine candidate to date. The vaccine has been under development since 1997 by Yerkes researcher Harriet Robinson and her colleagues at the National Institute of Allergy and Infectious Diseases and the Centers for Disease Control and Prevention. It was licensed for commercial use by GeoVax in 2004.

The new vaccine uses DNA to prime the immune response and a genetically modified "pox"-type virus to boost the immune response. Both vaccine components express noninfectious virus-like particles. Phase I clinical trials, conducted through the NIH-sponsored HIV Vaccine Trials Network, began in April, 2006, at the University of Alabama at Birmingham, the University of Maryland, and St. Louis University. If successful, the vaccine would face at least four more years of clinical testing. – *from the Summer, 2006,* NCRR Reporter

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Address Changes

Christian Abee, Doctor R. Lee Clark Professor and Chair, Dept of Veterinary Sciences; Director, Michale E. Keeling Center for Comparative Medicine and Research; University of Texas M. D. Anderson Cancer Center, 650 Cool Water Drive, Bastrop, Texas 78602.

AAALAC International, 5283 Corporate Dr., Suite 203, Frederick, MD 21703 [301-696-9626; fax: 301-696-9627].

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Volunteer Opportunities: Gibbon Conservation Center

The Gibbon Conservation Center (GCC) is a nonprofit organization in southern California that was founded in 1976 by Alan Mootnick. It is the only organization in the world that is devoted exclusively to the conservation, propagation, and study of gibbons (small apes) for the betterment of the species. We disseminate our findings through educational tours and publications, and by traveling the world assisting zoos and rescue centers. We are looking for help as follows:

1. Primate Keeper – cares for the animals and maintains the facilities and grounds. Depending on the time of year, work is 10-12 hours per day beginning in early morning, 7 days per week, and may also include Clerical and Center Assistant work (see below).
2. Center Assistant – may (depending on skills, needs of the Center, and personal preference) do maintenance of grounds, behavioral observations, cleaning of food preparation area, library research, fund-raising, and word processing. Center Assistants must keep a minimum distance of two meters from all enclosures.
3. Clerical Assistant – may (depending on skills, needs of the Center, and personal preference) do word processing, fund-raising, library research, and behavioral observations from a distance.

GCC provides free lodging to resident volunteers in an older, basic, travel trailer with free access to the bathroom, kitchen, and laundry facilities, in the house. Volunteers buy their own food and personal items, which cost approximately $100 – 200 per month at the local supermarkets (depending on the tastes of the volunteer).

Training, lasting approximately one week, is essential at GCC because the volunteers have to follow strict procedures that are mandated by law and our own goals of cleanliness, gibbon welfare and breeding, and safety for people and gibbons. The training involves working hands-on with an experienced primate keeper.

Contact: Patricia Dahle, Volunteer Coordinator, Gibbon Conservation Center, P.O. Box 800249, Santa Clarita, CA 91380 [661-943-4915, fax: 661-296-1237; e-mail: *gibboncenter@earthlink.net*] (phone 9 a.m. to 8 p.m. Pacific Time, please). Applications are on our Website, <www.gibboncenter.org/volunteering.htm>, or contact Patricia. Send the completed application with a cover letter, resume, and two letters of recommendation.

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Announcements from Publications

PNAS Back Issues Available

The *Proceedings of the National Academy of Sciences* (*PNAS*) announces that its legacy content dating back to Volume 1, issue 1, in 1915 is now digitally archived, searchable, and freely available on the *PNAS* Website at <www.pnas.org/contents-by-date.0.shtml>.

IJP Submission Goes Electronic

Springer, publisher of the *International Journal of Primatology* (*IJP*), announces that submission to *IJP* is now possible through Editorial Manager, a fully Web-enabled manuscript submission and review system offering authors the option of tracking the progress of their manuscripts through the review process in real time.

Manuscripts should be submitted to: <IJOP.edmgr.com>. For full instructions to authors, see <www.springer.com/10764>.

This mode of submission is preferred; however, as an alternative, four copies of the manuscript may be sent to Dr. Russell H. Tuttle, Department of Anthropology, The University of Chicago, 1126 East 59th St, Chicago, IL 60637.

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From the Primate Foundation of Arizona

On September 18, Jo Fritz sent the following announcement: "The Primate Foundation of Arizona (PFA) announced today it has transferred ownership of its animals to the federal government and will be closing in 2010. Over the next four years, the animals will be moved to the University of Texas (UT) M. D. Anderson Cancer Center in Bastrop, Texas, which has capacity for all of PFA's animals in its facility. Combining the PFA colony with UTs existing chimpanzees will improve the efficiency of managing both populations. In addition to reducing the costs of animal care, the move will make the entire population more readily accessible to researchers. As at PFA, the UT facility is AAALAC-accredited and provides social housing and indoor/outdoor enclosures. The new, state-of-the-art UT facility also has an on-site experienced veterinary staff and a nationally recognized environment enrichment and training program.

"Founded in 1976, PFA has had an uninterrupted 20-year history of NIH support for its chimpanzee colony, during which time it has maintained high standards of care. Funding began in 1986 when it was thought the animals would be needed for HIV/AIDS research, but scientists later discovered that the rhesus macaque monkey was a more appropriate model for that purpose."

Recent Books and Articles

(Addresses are those of first authors unless otherwise indicated)

Books

• *The Mammals of the South African Subregion, 3rd Revised Ed.* J. D. Skinner & C. T. Chimimba. West Nyack, NY: Cambridge University Press, 2006. [Price: $225]

Animals represented include galagos, baboons, and monkeys.

• *Apes, Monkeys, Children, and the Growth of Mind.* J. C. Gómez. Cambridge, MA: Harvard University Press, 2006. [Price: $19.95]

Magazines and Newsletters

• *BOS UK Newsletter*, August 2006, <www.savetheorangutan.co.uk/newsletter/august_06.pdf>. (Borneo Orangutan Survival Foundation, 68 Aston Abbotts Rd, Weedon, Aylesbury, Bucks, HP22 4NH, U.K.)

• *CC Update,* Summer 2006, *17*[2], <www.communityconservation.org/newsletter.htm>. (Community Conservation, Inc., 50542 One Quiet Lane, Gays Mills, WI 54631; [e-mail: *communityconservation@mwt.net*]).

• *CFAAR Arizona Newsletter*, 2006, *16*[2]. (Coalition for Animals & Animal Research, P.O. Box 210101, Tucson, AZ 85721-0101 [e-mail: *antrnweb@ahsc.arizona.edu*]).

• *European Zoo Nutrition Center Newsletter*, no. 18, <www.eznc.org/primosite/show.do?ctx=7795,43325,101129> (EZNC, P.O. Box 20164, 1000 HD Amsterdam, Netherlands).

Contents include: Silvery marmoset born in Wissel Zoo; and Composition and nutritional characteristics of fungi consumed by *Callimico goeldii* in Pando, Bolivia.

• *Folia Primatologica*, 2006, *77*[5].

Contents: Spontaneous tool use by wild capuchin monkeys (*Cebus libidinosus*) in the Cerrado, by I. C. Waga, A. K. Dacier, P. S. Pinha, & M. C. H. Tavares; Sexual swellings of female gibbons, by S. M. Cheyne & D. J. Chivers; High frequency of postcoital penis cleaning in Budongo chimpanzees, by S. J. O'Hara & P. C. Lee; Sanje Mangabey *Cercocebus sanjei* kills an African crowned eagle *Stephanoaetus coronatus*, by T. Jones, S. Laurent, F. Mselewa, & A. Mtui; Male dominance rank, mating and reproductive success in captive bonobos (*Pan paniscus*), by R. Maryan, J. M. G. Stevens, A. D. Roeder, I. Mazura, M. W. Bruford, & J. R. de Ruiter; Population dynamics of a group of lion-tailed macaques (*Macaca silenus*) inhabiting a rainforest fragment in the Western Ghats, India, by B. A. Krishna, M. Singh, & M. Singh; and Single-nucleotide polymorphisms in the epsilon-globin gene for differentiating primate infraorders, by M. Bosch, O. Andrés, & X. Domingo-Roura.

• *Primates: The Newsletter of the Mona Foundation*, July 2006, Issue 12, <www.mona-uk.org/assets/July%202006%20newsletter.pdf>.

• *Tacugama Chimpanzee Sanctuary Newsletter*, June, 2006. [To subscribe, see <www.mailchimp.com/subscribe.phtml?id=4a090dab0b>.]

Includes a detailed account of the violent escape of chimps from the sanctuary (see also *LPN*, 2006, *45*[3], 23).

• *Tropical Medicine and International Health,* 2006, *11*[8], <www.blackwell-synergy.com/toc/tmi/11/8>.

Contents include: An open, randomized comparison of artesunate plus mefloquine vs. dihydroartemisinin-piperaquine for the treatment of uncomplicated *Plasmodium falciparum* malaria in the Lao People's Democratic Republic (Laos), by M. Mayxay, V. Thongpraseuth, M. Khanthavong, N. Lindegardh, M. Barends, S. Keola, T. Pongvongsa, S. Phompida, R. Phetsouvanh, K. Stepniewska, N. J. White, & P. N. Newton; Insecticide-treated bednets for the prevention of *Plasmodium falciparum* malaria in Cambodia: A cluster-randomized trial, by T. Sochantha, S. Hewitt, C. Nguon, L. Okell, N. Alexander, S. Yeung, H. Vannara, M. Rowland, & D. Socheat; The effect of altitude on parasite density case definitions for malaria in northeastern Tanzania, by C. I. R. Chandler, C. J. Drakeley, H. Reyburn, & I. Carneiro; Gametocytocidal activity in antimalarial drugs speeds the spread of drug resistance, by I. M. Hastings; Classifying dengue: A review of the difficulties in using the WHO case classification for dengue haemorrhagic fever, by S. Bandyopadhyay, L. C. S. Lum, & A. Kroeger; and Who needs "pukka anthropologists"? A study of the perceptions of the use of anthropology in tropical public health research, by D. A. Napolitano & C. O. H. Jones.

Reports

• *Guidelines for the Humane Transportation of Laboratory Animals*. Committee on Guidelines for the Humane Transportation of Laboratory Animals, ILAR. Washington, DC: National Academies Press, 2006. [Price: $34.95; see <newton.nap.edu/catalog/11557.html>]

• *NC3Rs Guidelines: Primate Accommodation, Care and Use.* National Centre for the Replacement, Refinement and Reduction of Animals in Research, 2006. 20 pp. (NC3Rs, 20 Park Crescent, London W1B 1AL, U.K. [e-mail: *enquiries@nc3rs.org.uk*]).

We would like to acknowledge *Primate-Science* as a source for information about new books.

Special Journal Issues

• Type 2 Diabetes and Obesity. *ILAR Journal*, 2006, *47*[3], <www.nationalacademies.org/ilarjhome>.

Contents include Type 2 diabetes: An introduction to the development and use of animal models, by J. R. Kaplan & J. D. Wagner; Animal models of type 2 diabetes: Clinical presentation and pathophysiological relevance to the human condition, by W. T. Cefalu; Molecular approaches to study control of glucose homeostasis, by N. Neubauer & R. N. Kulkarni; and Old World nonhuman primate models of type 2 diabetes mellitus, by J. D. Wagner, K. Kavanagh, G. M. Ward, B. J. Auerbach, H. J. Harwood Jr., & J. R. Kaplan.

• The 23rd Annual Symposium on Non-human Primate Models for AIDS. *Journal of Medical Primatology*, 2006, *35*[4-5], <www.blackwell-synergy.com/toc/jmp/35/4-5>.

Contents: Introduction, by R. S. Veazey & L. J. Picker; Optimization of *in vitro* expansion of macaque $CD4^+$ T cells using anti-CD3 and co-stimulation for autotransfusion therapy, by N. Onlamoon, K. Hudson, P. Bryan, A. E. Mayne, M. Bonyhadi, R. Berenson, B. J. Sundstrom, P. Bostik, A. A. Ansari, & F. Villinger; Simian immunodeficiency viruses replication dynamics in African non-human primate hosts: Common patterns and species-specific differences, by I. Pandrea, G. Silvestri, R. Onanga, R. S. Veazey, P. A. Marx, V. Hirsch, & C. Apetrei; Initiation of antiretroviral therapy during chronic SIV infection leads to rapid reduction in viral loads and the level of T-cell immune response, by J. D. Boyer, S. Kumar, T. Robinson, R. Parkinson, L. Wu, M. Lewis, D. I. Watkins, & D. B. Weiner; Repetitive exposures with simian/human immunodeficiency viruses: Strategy to study HIV pre-clinical interventions in non-human primates, by C. N. Kim, D. R. Adams, S. Bashirian, S. Butera, T. M. Folks, & R. A. Otten; Systemic vaccination prevents the total destruction of mucosal CD4 T cells during acute SIV challenge, by J. J. Mattapallil, B. Hill, D. C. Douek, & M. Roederer; Foamy virus infection in primates, by S. M. Murray, & M. L. Linial; Can gene delivery close the door to HIV-1 entry after escape? by C. H. Swan & B. E. Torbett; Dynamic evolution of antibody populations in a rhesus macaque infected with attenuated simian immunodeficiency virus identified by surface plasmon resonance, by J. D. Steckbeck, H. J. Grieser, T. Sturgeon, R. Taber, A. Chow, J. Bruno, M. Murphy-Corb, R. C. Montelaro, & K. S. Cole; Gene expression profiling of gut mucosa and mesenteric lymph nodes in simian immunodeficiency virus-infected macaques with divergent disease course, by M. D. George, D. Verhoeven, Z. McBride, & S. Dandekar; and Abstracts of the Symposium.

• Cooperation and Altruism. *Journal of Evolutionary Biology*, 2006, *19*[5].

• Disease Risk Analysis. *American Journal of Primatology*, 2006, *68*[9]. Issue Edited by L. Jones-Engel.

Contents: Introduction: Disease risk analysis: A paradigm for using health-based data to inform primate conservation and public health, by L. Jones-Engel & G. A. Engel; Disease risk analysis: A tool for primate conservation planning and decision making, by D. A. Travis, L. Hungerford, G. A. Engel, L. Jones-Engel; Considering human–primate transmission of measles virus through the prism of risk analysis, by L. Jones-Engel, G. A. Engel, M. A. Schillaci, B. Lee, J. Heidrich, M. Chalise, & R. C. Kyes; Human culture and monkey behavior: Assessing the contexts of potential pathogen transmission between macaques and humans, by A. Fuentes; Using retrospective health data from the Gombe chimpanzee study to inform future monitoring efforts, by E. V. Lonsdorf, D. Travis, A. E. Pusey, & J. Goodall; Clinical response decision tree for the mountain gorilla (*Gorilla beringeii*) as a model for great apes, by the Decision Tree Writing Group; Anthrax in Western and Central African great apes, by F. H. Leendertz, F. Lankester, P. Guislain, C. Néel, O. Drori, J. Dupain, S. Speede, P. Reed, N. Wolfe, S. Loul, E. Mpoudi-Ngole, M. Peeters, C. Boesch, G. Pauli, H. Ellerbrok, & E. M. Leroy; and Risk assessment: A model for predicting cross-species transmission of simian foamy virus from macaques (*M. fascicularis*) to humans at a monkey temple in Bali, Indonesia, by G. Engel, L. L. Hungerford, L. Jones-Engel, D. Travis, R. Eberle, A. Fuentes, R. Grant, R. Kyes, M. Schillaci, & the Macaque Risk Analysis Workshop Group.

• IPPL Members' Meeting, 2006. *IPPL News,* June, 2005, *33*[1]. [International Primate Protection League, P.O. Box 766, Summerville, SC 29484; e-mail: *info@ippl.org*].

Anatomy and Physiology

• Do some taxa have better domain-general cognition than others? A meta-analysis of nonhuman primate studies. Deaner, R. O., van Schaik, C. P., & Johnson, V. (Dept of Neurobiol., Duke Univ. Med. Ctr, Box 3209, Durham, NC 27710 [e-mail: *deaner@neuro.duke.edu*]). *Evolutionary Psychology,* 2006, *4*, 149-196 <human-nature.com/ep>.

"Although much recent attention has focused on identifying domain-specific taxonomic differences in cognition, little effort has been directed towards investigating whether domain-general differences also exist. We therefore conducted a meta-analysis of published nonhuman primate cognition studies, testing the prediction that some taxa outperform others across a range of testing situations. First, within each of nine experimental paradigms with interspecific variation, we grouped studies by their procedures and the characteristics of their study subjects. Then, using Bayesian latent variable methods, we tested whether taxonomic differences consistently held within or across paradigms. No genus performed especially well within particular paradigms, but genera differed significantly in overall performance. In addition, there was evidence of variation

at higher taxonomic levels: most notably, great apes significantly outperformed other lineages. These results cannot be readily explained by perceptual biases or any other contextual confound and instead suggest that primate taxa differ in some kind of domain-general ability."

• Nonoptimal component placement, but short processing paths, due to long-distance projections in neural systems. Kaiser, M., & Hilgetag, C. C. (School of Comp. Sci., Univ. of Newcastle, Newcastle upon Tyne, U.K. [e-mail: *M.Kaiser@ncl.ac.uk*]). *PLoS Computational Biology*, 2006, *2*[7], <dx.doi.org/10.137/journal.pcbi.0020095>.

What constraints shape the organization and spatial layout of neural networks? One influential idea in theoretical neuroscience has been that the overall wiring of neural networks should be as short as possible. Wire-saving could be achieved, for instance, through an optimal spatial arrangement of the connected network components. The authors evaluated this concept of component placement optimization in two representative systems, the neuronal network of the *Caenorhabditis elegans* worm and the long-range cortical connections of the primate (macaque) brain. Contrary to previous results, they found many network layouts with substantially shorter total wiring than that of the original biological networks. This nonoptimal component placement arose from the existence of long-distance connections in the networks. Such connections may come at a developmental and metabolic cost; however, as the analyses reported in this article show, they also help to reduce the number of signal processing steps across the networks. Therefore, the organization of neural networks is shaped by trade-offs from multiple constraints, among them total wiring length and the average number of processing steps.

Animal Models

• Preclinical primate studies help bring new discoveries to patients. *NCRR Reporter*, Winter, 2006, <www.ncrr.nih.gov/newspub/Winter06rpt/Reporter_Winter2006.pdf>.

Includes brief reports on: Safeguarding new organs; Diagnostic tests for highly infectious agents; and Imaging agent aids neurological diagnoses.

• Vaccination preserves CD4 memory T cells during acute simian immunodeficiency virus challenge. Mattapallil, J. J., Douek, D. C., Buckler-White, A., Montefiori, D., Letvin, N. L., Nabel, G. J., & Roederer, M. (M. R., Vaccine Research Center, NIAID, NIH, Bethesda, MD 20892 [e-mail: *roederer@nih.gov*]). *Journal of Experimental Medicine*, 2006, *203,* 1533-1541.

"Acute simian immunodeficiency virus (SIV)/human immunodeficiency virus infection is accompanied by a massive destruction of CD4 memory T cells across all the tissue compartments. These early events set the course toward disease progression and immunodeficiency. Here, we demonstrate that prior vaccination reduces this destruction during acute SIV Mac_{251} infection, leading to better survival and long-term outcome. Systemic vaccination with a DNA-prime recombinant adenovirus boost regimen preserved memory CD4 T cells throughout the body. The vaccine regimen induced broad CD4 and CD8 T cell responses in all tissues examined and, importantly, induced antibodies that neutralized the primary isolate of SIV used for challenge. Finally, we demonstrate that the extent of preservation of the CD4 memory compartment during the acute phase provides a strong predictor for subsequent progression to death. Our data provide a mechanism to explain clinical observations that acute-phase viral loads predict long-term disease progression and underscore the need for interventions that protect against early destruction of CD4 memory T cells during acute infection."

• Baboons communicate with their right hand. Meguerditchian, A., & Vauclair, J. (Dept of Psychology, Research Center in Psychology of Cognition, Language & Emotion, Univ. of Provence, 29, Av. Robert Schuman, 13621 Aix-en-Provence, France [e-mail: *vauclair@up.univ-aix.fr*]). *Behavioural Brain Research,* 2006, *171,* 170-174.

"Humans are mainly right-handed for many actions including gestures. This bias is strongly linked to a left cerebral hemispheric dominance for language functions. Whether similar lateralized systems for communicative behaviors are present in other animals is unclear. Here we report the first evidence of strong population-level right-handedness in 60 captive baboons for a species-specific communicative manual gesture. Our findings support the view that lateralization for language may have evolved from a gestural system of communication controlled by the left hemisphere."

• Nogo-A–specific antibody treatment enhances sprouting and functional recovery after cervical lesion in adult primates. Freund, P., Schmidlin, E., Wannier, T., Bloch, J., Mir, A., Schwab, M. E., & Rouiller, E. M. (E. M. R., Dept of Med., Fac. of Sciences, Univ. of Fribourg, Chemin du Musée 5, CH-1700 Fribourg, Switzerland [e-mail: *Eric.Rouiller@unifr.ch*]). *Nature Medicine*, 2006, *12*, 790-792.

In rodents, after spinal lesion, neutralizing the neurite growth inhibitor Nogo-A promotes axonal sprouting and functional recovery. To evaluate this treatment in primates, 12 monkeys were subjected to cervical lesion. Recovery of manual dexterity and sprouting of corticospinal axons were enhanced in monkeys treated with Nogo-A–specific antibody as compared to monkeys treated with control antibody.

• Norm-based face encoding by single neurons in the monkey inferotemporal cortex. Leopold, D. A., Bondar, I. V., & Giese, M. A. (Lab. of Neuropsychology, NIMH, NIH, 49 Convent Dr., Bldg. 49, MSC 4400, Bethesda, MD 20892 [e-mail: *leopoldd@mail.nih.gov*]). *Nature,* 2006, *442*, 572-575.

"The rich and immediate perception of a familiar face, including its identity, expression and even intent, is one of the most impressive shared faculties of human and nonhuman primate brains. Many visually responsive neurons in the inferotemporal cortex of macaque monkeys respond selectively to faces, sometimes to only one or a few individuals, while showing little sensitivity to scale and other details of the retinal image. Here we show that face-responsive neurons in the macaque monkey anterior inferotemporal cortex are tuned to a fundamental dimension of face perception. Using a norm-based caricaturization framework previously developed for human psychophysics, we varied the identity information present in photo-realistic human faces, and found that neurons of the anterior inferotemporal cortex were most often tuned around the average, identity-ambiguous face. These observations are consistent with face-selective responses in this area being shaped by a figural comparison, reflecting structural differences between an incoming face and an internal reference or norm. As such, these findings link the tuning of neurons in the inferotemporal cortex to psychological models of face identity perception."

• Neuronal ensemble control of prosthetic devices by a human with tetraplegia. Hochberg, L. R., Serruya, M. D., Friehs, G. M., Mukand, J. A., Saleh, M., Caplan, A. H., Branner, A., Chen, D., Penn, R. D., & Donoghue, J. P. (J. P. D., Dept of Neurosci. & Brain Sci. Prog., Brown Univ., P.O. Box 1953, Providence, RI 02912 [e-mail: *john_donoghue@brown.edu*]). *Nature,* 2006, *442*, 164-171.

"Neuromotor prostheses (NMPs) aim to replace or restore lost motor functions in paralysed humans by routing movement-related signals from the brain, around damaged parts of the nervous system, to external effectors. To translate preclinical results from intact animals to a clinically useful NMP, movement signals must persist in cortex after spinal cord injury and be engaged by movement intent when sensory inputs and limb movement are long absent. Furthermore, NMPs would require that intention-driven neuronal activity be converted into a control signal that enables useful tasks. Here we show initial results for a tetraplegic human (MN) using a pilot NMP. Neuronal ensemble activity recorded through a 96-microelectrode array implanted in primary motor cortex demonstrated that intended hand motion modulates cortical spiking patterns three years after spinal cord injury. Decoders were created, providing a 'neural cursor' with which MN opened simulated e-mail and operated devices such as a television, even while conversing. Furthermore, MN used neural control to open and close a prosthetic hand, and perform rudimentary actions with a multi-jointed robotic arm. These early results suggest that NMPs based upon intracortical neuronal ensemble spiking activity could provide a valuable new neurotechnology to restore independence for humans with paralysis."

• A high-performance brain–computer interface. Santhanam, G., Ryu, S. I., Yu, B. M., Afshar, A., & Shenoy, K. V. (K. V. S., Neurosci. Program, Stanford Univ. Sch. of Med., Stanford, CA 94305 [e-mail: *shenoy@stanford.edu*]). *Nature,* 2006, *442*, 195-198.

"Recent studies have demonstrated that monkeys and humans can use signals from the brain to guide computer cursors. Brain–computer interfaces (BCIs) may one day assist patients suffering from neurological injury or disease, but relatively low system performance remains a major obstacle. In fact, the speed and accuracy with which keys can be selected using BCIs is still far lower than for systems relying on eye movements. This is true whether BCIs use recordings from populations of individual neurons using invasive electrode techniques or electroencephalogram recordings using less- or non-invasive techniques. Here we present the design and demonstration, using electrode arrays implanted in monkey dorsal premotor cortex, of a manyfold higher performance BCI than previously reported. These results indicate that a fast and accurate key selection system, capable of operating with a range of keyboard sizes, is possible (up to 6.5 bits per second, or ~15 words per minute, with 96 electrodes). The highest information throughput is achieved with unprecedentedly brief neural recordings, even as recording quality degrades over time. These performance results and their implications for system design should substantially increase the clinical viability of BCIs in humans."

Animal Welfare

• Human-animal relationship in the research lab: A discussion by the Refinement & Enrichment Forum. *Animal Technology and Welfare*, 2006, *5*, 95-98, <www.awionline.org/Lab_animals/biblio/atw11.html>.

• Stress and distress: A discussion by the Refinement & Enrichment Forum. *Animal Technology and Welfare*, 2006, *5*, 99-102, <www.awionline.org/Lab_animals/biblio/atw12.html>.

Behavior

• Chimpanzees use stone hammers in Cameroon. Morgan, B. J., & Abwe, E. E. (CRES, Zool. Soc. of San Diego, 15600 San Pasqual Valley Rd, Escondido, CA 92027-7000 [e-mail: *bmorgan@sandiegozoo.org*]). *Current Biology*, 2006, *16*, R632-R633.

"All studied chimpanzee populations use tools, with differences in behavioral repertoires between populations implying significant cultural variation, but the only major known tool-using behavior that is geographically confined to a single contiguous region is the absence of nut-cracking in all populations east of the N'Zo-Sassandra River in Côte

d'Ivoire. Nut-cracking is the paradigmatic example of a nutritionally high-value, socially transmitted tradition and here we report that chimpanzees in the Ebo forest, Cameroon, more than 1700 km east of the previously proposed riverine 'information barrier' in Côte d'Ivoire, have been observed to crack the hard shelled nuts of *Coula edulis* with stones used as hammers, so as to access the nutrient-rich seeds. This observation challenges the existing model of the cultural diffusion of nut-cracking behavior by implying that it has been invented on multiple occasions; alternatively, if nut-cracking is an ancient trait in the western chimpanzee populations then there have been extinctions of the behavior in areas between the N'Zo-Sassandra River and the Ebo forest."

• Faithful replication of foraging techniques along cultural transmission chains by chimpanzees and children. Horner, V., Whiten, A., Flynn, E., & de Waal, F. B. M. (Centre for Social Learning and Cognitive Evolution, School of Psychology, University of St. Andrews, Fife KY16 9JP, U.K. [e-mail: *vhorner@rmy.emory.edu*]). *Proceedings of the National Academy of Sciences, U.S.A.*, 2006, *103*, 13878-13883.

"Observational studies of wild chimpanzees (*Pan troglodytes*) have revealed population-specific differences in behavior, thought to represent cultural variation. Field studies have also reported behaviors indicative of cultural learning, such as close observation of adult skills by infants, and the use of similar foraging techniques within a population over many generations. Although experimental studies have shown that chimpanzees are able to learn complex behaviors by observation, it is unclear how closely these studies simulate the learning environment found in the wild. In the present study we have used a diffusion chain paradigm, whereby a behavior is passed from one individual to the next in a linear sequence in an attempt to simulate intergenerational transmission of a foraging skill. Using a powerful three-group, two-action methodology, we found that alternative methods used to obtain food from a foraging device ('lift door' versus 'slide door') were accurately transmitted along two chains of six and five chimpanzees, respectively, such that the last chimpanzee in the chain used the same method as the original trained model. The fidelity of transmission within each chain is remarkable given that several individuals in the no-model control group were able to discover either method by individual exploration. A comparative study with human children revealed similar results. This study is the first to experimentally demonstrate the linear transmission of alternative foraging techniques by nonhuman primates. Our results show that chimpanzees have a capacity to sustain local traditions across multiple simulated generations."

Development and Aging

• Neonatal imitation in rhesus macaques. Ferrari, P. F., Visalberghi, E., Paukner, A., Fogassi, L., Ruggiero, A., & Suomi, S. J. (Dipto di Biol. Evolutiva e Funzionale, Univ. di Parma, Parma, Italy [e-mail: *Ferrari@biol.unipr.it]). PLoS Biology*, 2006, *4*[9], e302.

"The emergence of social behaviors early in life is likely crucial for the development of mother–infant relationships. Some of these behaviors, such as the capacity of neonates to imitate adult facial movements, were previously thought to be limited to humans and perhaps the ape lineage. Here we report the behavioral responses of infant rhesus macaques *(Macaca mulatta)* to the following human facial and hand gestures: lip smacking, tongue protrusion, mouth opening, hand opening, and opening and closing of eyes (control condition). In the third day of life, infant macaques imitate lip smacking and tongue protrusion. On the first day of life, the model's mouth openings elicited a similar matched behavior (lip smacking) in the infants. These imitative responses are present at an early stage of development, but they are apparently confined to a narrow temporal window. Because lip smacking is a core gesture in face-to-face interactions in macaques, neonatal imitation may serve to tune infants' affiliative responses to the social world. Our findings provide a quantitative description of neonatal imitation in a nonhuman primate species and suggest that these imitative capacities, contrary to what was previously thought, are not unique to the ape and human lineage. We suggest that their evolutionary origins may be traced to affiliative gestures with communicative functions."

Diet and Nutrition

• Comparison of serum iron, total iron binding capacity, ferritin, and percent transferrin saturation in nine species of apparently healthy captive lemurs, Williams, C. V., Campbell, J., & Glenn, K. M. (3705 Erwin Road, Durham, NC 27705 [e-mail: *cathy.williams@duke.edu*]). *American Journal of Primatology*, 2006, *68*, 477-489.

Lemurs kept in captivity have been reported to be highly prone to accumulate excessive amounts of iron in tissues (hemosiderosis). Diagnosis of the condition is most commonly made during a postmortem examination because an antemortem diagnosis requires a liver biopsy, a procedure that may not be well tolerated by all animals. The lack of a noninvasive method to evaluate iron status in captive lemurs limits investigators' ability to effectively screen animals for the presence of hemosiderosis, and to detect the condition early when treatment protocols are most effective. This study was conducted in an effort to provide data regarding iron analyte values in healthy captive lemurs of multiple species. The relationship of various iron-related metabolites was evaluated in 177 clinically normal lemurs of nine different species. Serum iron (sI), total iron binding capacity (TIBC), and ferritin concentration were measured directly and the percent transferrin saturation (TS) was calculated. Significant differences in various iron metabolites were observed among several species, suggesting that normal reference values for iron me-

tabolites in lemurs may need to be developed on a species by species basis.

• Decaying wood is a sodium source for mountain gorillas. Rothman, J. M., Van Soest, P. J., & Pell, A. N. (Cornell Univ. Dept of Animal Sci., Ithaca, NY 14853 [e-mail: *jmr12@cornell.edu*]). *Biology Letters*, 2006, *2*, 242-245.

"Like several other nonhuman primates, mountain gorillas (*Gorilla beringei beringei*) in Bwindi Impenetrable National Park, Uganda, consume decaying wood, an interesting but puzzling behavior. This wood has little obvious nutritional value; it is low in protein and sugar, and high in lignin compared to other foods. We collected pieces of wood eaten and avoided by gorillas, and other foods consumed by gorillas, and measured their sodium content. Wood was substantially higher in sodium than other dietary items, and wood pieces from stumps eaten contained more sodium than those that were avoided. Wood represented only 3.9% of the wet weight food intake of gorillas, but contributed over 95% of dietary sodium, leading us to conclude that decaying wood is an important sodium source for Bwindi gorillas. Because sodium has been leached from the weathered soils characteristic of the subhumid and humid tropics, and because terrestrial plants generally do not require sodium, tropical herbivores, including gorillas, often encounter problems locating the sodium essential for their well-being. Decaying wood is an unexpected sodium source."

Disease

• Gorilla susceptibility to Ebola virus: The cost of sociality. Caillaud, D., Levréro, F., Cristescu. R., Gatti, S., Dewas, M., Douadi, M., Gautier-Hion, A., Raymond, M., & Ménard, N. (UMR 5554 Inst des Sciences de l'Evolution, CNRS/Univ. de Montpellier 2, CC 065, 34095 Montpellier Cedex 5, France [e-mail: *caillaud@isem.univ-montp2.fr*]). *Current Biology*, 2006, *16*, R489-R491.

Since 1994, there have been nine human Ebola-Zaire virus (EBOV) outbreaks in eastern Gabon and northwestern Congo. A majority of them originated from the handling of ape carcasses found by local hunters. The impact of Ebola-Zaire virus on great ape density is suspected to be high, but neither the demographic consequences of outbreaks nor the way the virus spreads within an ape population are well known. The large population of western lowland gorillas, *Gorilla gorilla gorilla*, monitored since 2001 at the Lokoué clearing, Odzala-Kokoua National Park, Congo, was affected in 2004, providing an opportunity to address both questions using an original statistical approach mixing capture-recapture and epidemiological models. The social structure of gorillas strongly influenced the spread of EBOV. Individuals living in groups appeared to be more susceptible than solitary males, with respective death rates of 97% and 77%. The outbreak lasted around a year, during which gorilla social units (group or solitaries) were infected either directly from a reservoir or from contaminated individuals.

• Malaria risk on the Amazon frontier. Caldas de Castro, M., Monte-Mór, R. L., Sawyer, D. O., & Singer, B. H. (Dept of Geography, Univ. of South Carolina, Columbia, SC 29208 [e-mail: *mcaldas@sc.edu*]). *Proceedings of the National Academy of Sciences, U.S.A.*, 2006, *103*, 2452-2457.

"Frontier malaria is a biological, ecological, and sociodemographic phenomenon operating over time at three spatial scales (micro/individual, community, and state and national). We explicate these linkages by integrating data from remote sensing surveys, ground-level surveys, and ethnographic appraisal, focusing on the Machadinho settlement project in Rondônia, Brazil. Spatially explicit analyses reveal that the early stages of frontier settlement are dominated by environmental risks, consequential to ecosystem transformations that promote larval habitats of *Anopheles darlingi*. With the advance of forest clearance and the establishment of agriculture, ranching, and urban development, malaria transmission is substantially reduced, and risks of new infection are largely driven by human behavioral factors. Malaria mitigation strategies for frontier settlements require a combination of preventive and curative methods and close collaboration between the health and agricultural sectors. Of fundamental importance is matching the agricultural potential of specific plots to the economic and technical capacities of new migrants. Equally important is providing an effective agricultural extension service."

• Chimpanzee reservoirs of pandemic and nonpandemic HIV-1. Keele, B. F., Van Heuverswyn, F., Li, Y., Bailes, E., Takehisa, J., Santiago, M. L., Bibollet-Ruche, F., Chen, Y., Wain, L. V., Liegeois, F., Loul, S., Ngole, E. M., Bienvenue, Y., Delaporte, E., Brookfield, J. F. Y., Sharp, P. M., Shaw, G. M., Peeters, M., & Hahn, B. H. (B. H. H., Depts of Medicine and Microbiology, Univ. of Alabama, Birmingham, AL 35294 [e-mail: *bhahn@uab.edu*]). *Science*, 2006, *313*, 523-526.

"Human immunodeficiency virus type 1 (HIV-1), the cause of human AIDS, represents a zoonotic infection of staggering proportions and social impact. Yet, uncertainty persists regarding its natural reservoir. The virus most closely related to HIV-1 is a simian immunodeficiency virus (SIV) thus far identified only in captive members of the chimpanzee subspecies *Pan troglodytes troglodytes*. Here, we report the detection of SIVcpz antibodies and nucleic acids in fecal samples from wild-living *P. t. troglodytes* apes in southern Cameroon where prevalence rates in some communities reached 29 to 35%. By sequence analysis of endemic SIVcpz strains, we could trace the origins of pandemic (group M) and non-pandemic (group N) HIV-1 to distinct, geographically isolated chimpanzee communities. These findings establish *P. t. troglodytes* as the natural reservoir of HIV-1."

Evolution, Genetics, and Taxonomy

• Initial sequence of the chimpanzee genome and comparison with the human genome. The Chimpanzee Sequencing and Analysis Consortium (R. H. Waterston, Genome Science, Univ. of Washington School of Medicine, 1705 NE Pacific St, Seattle, WA 98195 [e-mail: *waterston@gs.washington.edu*]).] *Nature,* 2005, *437,* 69-87.

"Here we present a draft genome sequence of the common chimpanzee (*Pan troglodytes*). Through comparison with the human genome, we have generated a largely complete catalogue of the genetic differences that have accumulated since the human and chimpanzee species diverged from our common ancestor, constituting approximately thirty-five million single-nucleotide changes, five million insertion/deletion events, and various chromosomal rearrangements. We use this catalogue to explore the magnitude and regional variation of mutational forces shaping these two genomes, and the strength of positive and negative selection acting on their genes. In particular, we find that the patterns of evolution in human and chimpanzee protein-coding genes are highly correlated and dominated by the fixation of neutral and slightly deleterious alleles. We also use the chimpanzee genome as an outgroup to investigate human population genetics and identify signatures of selective sweeps in recent human evolution."

• Snakes as agents of evolutionary change in primate brains, Isbell, L. A. (Dept of Anthropology, Univ. of California, Davis, CA 95616 [e-mail: *laisbell@ucdavis.edu*]). *Journal of Human Evolution*, 2006, *51*, 1-35.

"Current hypotheses that use visually guided reaching and grasping to explain orbital convergence, visual specialization, and brain expansion in primates are open to question now that neurological evidence reveals no correlation between orbital convergence and the visual pathway in the brain that is associated with reaching and grasping. An alternative hypothesis proposed here posits that snakes were ultimately responsible for these defining primate characteristics. Snakes have a long, shared evolutionary existence with crown-group placental mammals and were likely to have been their first predators. Mammals are conservative in the structures of the brain that are involved in vigilance, fear, and learning and memory associated with fearful stimuli, e.g., predators. Some of these areas have expanded in primates and are more strongly connected to visual systems. However, primates vary in the extent of brain expansion. This variation is coincident with variation in evolutionary co-existence with the more recently evolved venomous snakes. Malagasy prosimians have never coexisted with venomous snakes, New World monkeys (platyrrhines) have had interrupted coexistence with venomous snakes, and Old World monkeys and apes (catarrhines) have had continuous coexistence with venomous snakes. The koniocellular visual pathway, arising from the retina and connecting to the lateral geniculate nucleus, the superior colliculus, and the pulvinar, has expanded along with the parvocellular pathway, a visual pathway that is involved with color and object recognition. I suggest that expansion of these pathways co-occurred, with the koniocellular pathway being crucially involved (among other tasks) in pre-attentional visual detection of fearful stimuli, including snakes, and the parvocellular pathway being involved (among other tasks) in protecting the brain from increasingly greater metabolic demands to evolve the neural capacity to detect such stimuli quickly. A diet that included fruits or nectar (though not to the exclusion of arthropods), which provided sugars as a neuroprotectant, may have been a required preadaptation for the expansion of such metabolically active brains. Taxonomic differences in evolutionary exposure to venomous snakes are associated with similar taxonomic differences in rates of evolution in cytochrome oxidase genes and in the metabolic activity of cytochrome oxidase proteins in at least some visual areas in the brains of primates. Raptors that specialize in eating snakes have larger eyes and greater binocularity than more generalized raptors, and provide non-mammalian models for snakes as a selective pressure on primate visual systems. These models, along with evidence from paleobiogeography, neuroscience, ecology, behavior, and immunology, suggest that the evolutionary arms race begun by constrictors early in mammalian evolution continued with venomous snakes. Whereas other mammals responded by evolving physiological resistance to snake venoms, anthropoids responded by enhancing their ability to detect snakes visually before the strike."

• Genetic evidence for complex speciation of humans and chimpanzees. Patterson, N., Richter, D. J., Gnerre, S., Lander, E. S., & Reich, D. (D. Reich, Dept of Genetics, Harvard Med. School, Boston, MA 02115 [e-mail: *reich@genetics.med.harvard.edu*]). *Nature,* 2006, *441*, 1103-1108.

"The genetic divergence time between two species varies substantially across the genome, conveying important information about the timing and process of speciation. Here we develop a framework for studying this variation and apply it to about 20 million base pairs of aligned sequence from humans, chimpanzees, gorillas and more distantly related primates. Human–chimpanzee genetic divergence varies from less than 84% to more than 147% of the average, a range of more than 4 million years. Our analysis also shows that human–chimpanzee speciation occurred less than 6.3 million years ago and probably more recently, conflicting with some interpretations of ancient fossils. Most strikingly, chromosome X shows an extremely young genetic divergence time, close to the genome minimum along nearly its entire length. These unexpected features would be explained if the human and chimpanzee lineages initially diverged, then later exchanged genes before separating permanently."

• Rapid Asia–Europe–North America geographic dispersal of earliest Eocene primate *Teilhardina* during the Paleocene–Eocene Thermal Maximum. Smith, T., Rose, K. D., & Gingerich, P. D. (Dept of Paleontology, Royal Belgian Inst. of Natural Sciences, 29 Rue Vautier, B-1000 Brussels, Belgium [e-mail: *thierry.smith@naturalsciences.be*]). *Proceedings of the National Academy of Sciences, U.S.A.*, 2006, *103*, 11223-11227.

True primates appeared suddenly on all three northern continents during the 100,000-yr-duration Paleocene–Eocene Thermal Maximum at the beginning of the Eocene, ≈55.5 mya. The simultaneous or nearly simultaneous appearance of euprimates on northern continents has been difficult to understand because the source area, immediate ancestors, and dispersal routes were all unknown. Now, omomyid haplorhine *Teilhardina* is known on all three continents in association with the carbon isotope excursion marking the Paleocene–Eocene Thermal Maximum. Relative position within the carbon isotope excursion indicates that Asian *Teilhardina asiatica* is oldest, European *Teilhardina belgica* is younger, and North American *Teilhardina brandti* and *Teilhardina americana* are, successively, youngest. Analysis of morphological characteristics of all four species supports an Asian origin and a westward Asia-to-Europe-to-North America dispersal for *Teilhardina*. High-resolution isotope stratigraphy indicates that this dispersal happened in an interval of ≈25,000 years. Rapid geographic dispersal and morphological character evolution in *Teilhardina* reported here are consistent with rates observed in other contexts.

• Species-specific calls activate homologs of Broca's and Wernicke's areas in the macaque. Gil-da-Costa, R., Martin, A., Lopes, M. A., Muñoz, M., Fritz, J. B., & Braun, A. R. (A. R. B., National Inst. on Deafness & Other Communication Disorders, NIH, Bethesda, MD 20892 [e-mail: *brauna@nidcd.nih.gov*]). *Nature Neuroscience,* 2006, *9,* 1064-1070.

"The origin of brain mechanisms that support human language – whether these originated *de novo* in humans or evolved from a neural substrate that existed in a common ancestor – remains a controversial issue. Although the answer is not provided by the fossil record, it is possible to make inferences by studying living species of nonhuman primates. Here we identified neural systems associated with perceiving species-specific vocalizations in rhesus macaques using $H_2\ ^{15}O$ positron emission tomography (PET). These vocalizations evoke distinct patterns of brain activity in homologs of the human perisylvian language areas. Rather than resulting from differences in elementary acoustic properties, this activity seems to reflect higher-order auditory processing. Although parallel evolution within independent primate species is feasible, this finding suggests the possibility that the last common ancestor of macaques and humans, which lived 25–30 million years ago, possessed key neural mechanisms that were plausible candidates for exaptation during the evolution of language."

• Expression profiling in primates reveals a rapid evolution of human transcription factors. Gilad, Y., Oshlack, A., Smyth, G. K., Speed, T. P., & White, K. P. (Dept of Human Genetics, Univ. of Chicago, Chicago, IL 60605 [e-mail: *gilad@uchicago.edu*]. *Nature*, 2006, *440*, 242-245.

"Although it has been hypothesized for thirty years that many human adaptations are likely to be due to changes in gene regulation, almost nothing is known about the modes of natural selection acting on regulation in primates. Here we identify a set of genes for which expression is evolving under natural selection. We use a new multi-species complementary DNA array to compare steady-state messenger RNA levels in liver tissues within and between humans, chimpanzees, orangutans and rhesus macaques. Using estimates from a linear mixed model, we identify a set of genes for which expression levels have remained constant across the entire phylogeny (~70 million years), and are therefore likely to be under stabilizing selection. Among the top candidates are five genes with expression levels that have previously been shown to be altered in liver carcinoma. We also find a number of genes with similar expression levels among non-human primates but significantly elevated or reduced expression in the human lineage, features that point to the action of directional selection. Among the gene set with a human-specific increase in expression, there is an excess of transcription factors; the same is not true for genes with increased expression in chimpanzee."

• Comment on "The brain of LB1, *Homo floresiensis*". Martin, R. D., MacLarnon, A. M., Phillips, J. L., Dussubieux, L., Williams, P. R., & Dobyns, W. B. (The Field Museum, Chicago, IL 60605–2496 [e-mail: *rdmartin@fieldmuseum.org*]). *Science*, 2006, *312*, 997-998.

Endocast analysis of the brain *Homo floresiensis* by Falk et al. (Reports, 8 April 2005, p. 242) implies that the hominid is an insular dwarf derived from *H. erectus*, but its tiny cranial capacity cannot result from normal dwarfing. Consideration of more appropriate microcephalic syndromes and specimens supports the hypothesis of modern human microcephaly.

• Response to Comment on "The brain of LB1, *Homo floresiensis*". Falk, D., Hildebolt, C., Smith, K., Morwood, M. J., Sutikna, T., Jatmiko, Saptomo, E. W., Brunsden, B., & Prior, F. (Dept of Anthropology, Florida State University, Tallahassee, FL 32306 [e-mail: *dfalk@fsu.edu*]). *Science*, 2006, *312*, 999.

Martin et al. claim that they have two endocasts from microcephalics that appear similar to that of LB1, *Homo floresiensis*. However, the line drawings they present as evidence lack details about the transverse sinuses, cerebellum, and cerebral poles. Comparative measurements, actual photographs, and sketches that identify key features

are needed to draw meaningful conclusions about Martin et al.'s assertions.

• Pygmoid Australomelanesian *Homo sapiens* skeletal remains from Liang Bua, Flores: Population affinities and pathological abnormalities. Jacob, T., Indriati, E., Soejono, R. P., Hsü, K., Frayer, D. W., Eckhardt, R. B., Kuperavage, A. J., Thorne, A., & Henneberg, M. (K. H., Center for Integrated Hydrologic Circuits Development, Nat. Inst. of Earth Sciences, Beijing 100101, China [e-mail: *kenjhsu@aol.com*]). *Proceedings of the National Academy of Sciences, U.S.A.*, 2006, *103*, 13421-13426.

"Liang Bua 1 (LB1) exhibits marked craniofacial and postcranial asymmetries and other indicators of abnormal growth and development. Anomalies aside, 140 cranial features place LB1 within modern human ranges of variation, resembling Australomelanesian populations. Mandibular and dental features of LB1 and LB6/1 either show no substantial deviation from modern *Homo sapiens* or share features (receding chins and rotated premolars) with Rampasasa pygmies now living near Liang Bua Cave. We propose that LB1 is drawn from an earlier pygmy *H. sapiens* population but individually shows signs of a developmental abnormality, including microcephaly. Additional mandibular and postcranial remains from the site share small body size but not microcephaly."

Facilities

• Occupational health in animal care, use and research. Hankensen, F. C. In J. D. Reuter & M. A. Suckow (Eds.), *Laboratory Animal Medicine and Management.* Ithaca, NY: International Veterinary Information Service, 2006.

Reproduction

• Male mate choice in *Lemur catta*. Parga, J. A. (Dept of Anthropology, Univ. of Texas, University Station, Austin, TX 78712 [e-mail: *jparga@bu.edu*]). *International Journal of Primatology,* 2006, *27*, 107-131.

"Though females are generally more selective in mate choice, males may also derive reproductive benefits from exercising mate selectivity if one or more factors limit male reproductive success and females differ in reproductive potential. I used male mating effort as a proxy for male mate choice in ring-tailed lemurs. I calculated mating effort as the rate of male-male agonism during each female's estrous period 30 min before and 30 min after the first and last mountings with intromission. I collected data on one free-ranging *Lemur catta* troop during two consecutive breeding seasons on St. Catherines Island (Georgia, U.S.A.). In both years, male mating effort differed significantly among troop females once I adjusted male-male agonistic rates to reflect agonistic intensity, and I corrected for the number of observed mates per female (2000: $X^2 = 27.43$, df = 3, $p < 0.0001$; 2001: $X^2 = 21.10$, df = 3, $p < 0.001$). Results strongly suggest male mate choice. Contrary to expectation, males did not expend the greatest mating effort for females with the highest dominance status nor the highest reproductive success. Males preferred females that either: (1) belonged to the age class in which fecundity and infant survival is the highest at this site (4-9 yrs), or 2) were older females (≥ yrs) with high reproductive success. Female reproductive potential appears to be an important variable determining male mating effort in *Lemur catta*."

• High-resolution X-ray computed tomography scanning of primate copulatory plugs. Parga, J. A., Maga, M., & Overdorff, D. J. (Address same as above). *American Journal of Physical Anthropology,* 2006, *129*, 567-576.

"In this study, high-resolution computed tomography X-ray scanning was used to scan ring-tailed lemur (*Lemur catta*) copulatory plugs. This method produced accurate measures of plug volume and surface area, but was not useful for visualizing plug internal structure. Copulatory plug size was of interest because it may relate to male fertilization success. Copulatory plugs form from coagulated ejaculate, and are routinely displaced in this species by the penis of a subsequent mate during copulation. Because one potential function of these plugs may be to preclude or delay other males' successful insemination of females, we tested the hypothesis that larger plugs are more difficult for subsequent males to displace. Plugs were collected opportunistically upon displacement during data collection on *L. catta* mating behavior on St. Catherines Island, during two subsequent breeding seasons. Copulatory plugs exhibited a wide range of volumes: 1,758 – 5,013.6 mm^3 (n = 9). Intraindividual differences in plug volume were sometimes greater than interindividual differences. Contrary to predictions, larger plugs were not more time-consuming for males to displace via penile intromission during copulation. Nor were plugs with longer vaginal residence times notably smaller than plugs with shorter residence times, as might be expected if plugs disintegrate while releasing sperm. We found a significant inverse correlation between number of copulatory mounts leading to ejaculation and copulatory plug volume. This may indicate that if males are sufficiently sexually aroused to reach ejaculation in fewer mounts, they tend to produce ejaculates of greater volume."

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