LABORATORY PRIMATE NEWSLETTER

Volume 9, Number 4

October, 1970

Edited by

Allan M. Schrier

Consulting Editor: Morris L. Povar

Psychology Department
Brown University
Providence, Rhode Island

POLICY STATEMENT

The primary purpose of the *Laboratory Primate Newsletter* is to provide information on maintenance, breeding, and procurement of nonhuman primates for laboratory studies. A secondary purpose is to disseminate general information about the world of primate research. Requests for information, for special equipment, or for animal tissues or animals with special characteristics will be included in the *Newsletter*. As a rule, the only research articles or summaries that will be accepted for the *Newsletter* are those that have some practical implications or that provide general information likely to be of interest to investigators in a variety of areas of primate research. However, special consideration will be given to articles containing data on primates not conveniently publishable elsewhere. General descriptions of current research projects on primates will also be welcome.

The *Newsletter* appears quarterly and is intended primarily for persons doing research with nonhuman primates. There is no charge for new issues or the current issue. Volumes 1-4 may be purchased for $4.00 per volume, Volumes 5-8 for $2.50 per volume, and back issues for the current year for $0.50 each. (Please make checks payable to Brown University.)

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

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

All correspondence concerning the *Newsletter* should be addressed to:
Allan M. Schrier, Psychology Department, Brown University, Providence, Rhode Island 02912.

ACKNOWLEDGMENT

The *Newsletter* is supported in part by U.S. Public Health Service Grant FR-00419 from the Division of Research Facilities and Resources, N.I.H.

Managing Editor: Kathryn M. Huntington

CONTENTS

NOTE ON STUDIES TO DETERMINE THE POSSIBILITY OF A NATURAL RESERVOIR OF SMALLPOX AND REQUEST FOR INFORMATION

I. Arita

Smallpox Eradication Unit

World Health Organization, Geneva, Switzerland

In the context of the worldwide smallpox eradication program which started in 1967, a concerted effort has been made to determine whether or not a natural reservoir of smallpox might exist in nonhuman primates. This seemed particularly imperative considering the unfortunate experiences in the past with both yellow fever and malaria, neither disease having originally been recognized as having animal reservoirs. Additionally, in 1958, monkeypox virus was identified as the cause of five outbreaks in captive monkey colonies (von Magnus, Andersen, Petersen, & Birch-Andersen, 1959; Arita & Henderson, 1968) and this virus was found to be very closely related to the variola-vaccinia viruses.

In July 1967, questionnaires were sent to 26 major biological manufacturers or institutions throughout the world, where a large number of monkeys were being handled, to obtain information on their past experience with pox disease outbreaks in monkeys. At that time, particular attention was called to the occurrence of outbreaks caused by monkeypox virus. From this survey, information on four monkeypox outbreaks was added to that on the five outbreaks already known. In these outbreaks no human monkeypox infections in handlers or others were reported. That only nine outbreaks had been recognized in captive monkey colonies suggested that such incidents were uncommon.

In parallel with this survey, all the available literature reporting naturally occurring pox diseases in monkeys since the eighteenth century was scrutinized. Only two reports were found describing smallpox outbreaks in the wild monkey population. Neither of these outbreaks was confirmed virologically. Further, present knowledge of monkeypox, as well as recent observations on vesicular disease in monkeys caused by herpes virus T (Holmes, Devine, Nowakowski, & Deinhardt, 1966), suggests that one or both of these outbreaks might have been caused by this agent rather than smallpox or monkeypox. Considering the widespread occurrence of smallpox in man in Asia, America, and Africa, this search of the literature suggests that the incidence of pox diseases is also rare in wild monkeys.

In addition to these investigations, a serological survey on pox virus antibody in monkey sera was initiated in 1968. To date, 2000 sera of various species from Africa and Asia have been tested. Additional serological studies of sera from cynomolgus monkeys (*Macaca fascicularis*) from Malaysia have also been initiated and will be completed in September 1970. These latter studies were begun after at least two monkeypox outbreaks, confirmed by virus isolation, were recognized in captive monkey

colonies originating from that area. To date, collaborating laboratories have not detected antibody against the variola-vaccinia-monkeypox group of viruses in any of the specimens.

Thus, all the evidence so far obtained would strongly suggest that there is no natural reservoir of smallpox in nonhuman primates.

At the same time, the smallpox eradication program has progressed as planned and 12 of the 30 countries in which smallpox was endemic in 1967 when the program began are now free of the disease. Based on present progress, it is believed that the eradication of smallpox could be achieved this decade. Thus, further confirmation of the absence of a natural reservoir of smallpox becomes increasingly important. Detection and investigation of any outbreaks in monkeys suspected to be caused by smallpox or monkeypox virus is vital. Constant surveillance in laboratories as well as in the field is required.

The World Health Organization would be most grateful to receive information from any investigator or laboratory regarding the occurrence since 1967 of pox disease in monkeys (Yaba or Yaba-like disease and herpes T disease occurrence can be excluded).[1] Information of interest would include: (1) Date, place of outbreak, and number of cases. (2) Laboratory characteristics of the causative agent. (3) Source of monkeys, species, interval between arrival and onset of illness, and possible source of infection. (4) Concomitant illness in laboratory personnel which might be related to the outbreak. (5) Any other pertinent information.

If no outbreaks have been observed, a brief note to this effect would also be very helpful.

REFERENCES

Arita, I., & Henderson, D. A. Smallpox and monkeypox in non-human primates. *Bulletin of the World Health Organization*, 1968, *39*, 277-283.

Holmes, A. W., Devine, J. A., Nowakowski, E., & Deinhardt, F. The epidemiology of a herpes virus infection of New World monkeys. *Journal of Immunology*, 1968, *96*, 668-671.

Magnus, P. von, Andersen, E. K., Petersen, K. B., & Birch-Andersen, A. A pox-like disease in cynomolgus monkeys. *Acta Pathologica et Microbiologica Scandinavica*, 1959, *46*, 156-176.

---

[1]This information should be sent to: Smallpox Eradication Unit, World Health Organization, 1211 Geneva 27, Switzerland.

OBSERVATIONS OF TWO INFANT BUSHBABIES, *GALAGO SENEGALENSIS*

Jeannette P. Ward and Sharon Scott

Memphis State University, Memphis, Tenn. 38111

Although a considerable literature exists on the morphology and behavior of bushbabies as summarized by Napier and Napier (1967), to our knowledge the study of Sauer and Sauer (1963) constitutes the only record of the growth and development of *Galago senegalensis*. In the past year we have had occasion to observe two infant bushbabies. One of these was permitted to remain with the parents in the home cage; the other was separated from the mother and hand-reared. This is a brief report of some observations of these two captive-born infants.

An infant with mother.--On April 7, 1969, a pair of bushbabies which had been held by an animal dealer during the preceding winter were received at this laboratory. They were accompanied by a young male infant stated to be less than two weeks of age. All three animals were in good condition on arrival. The infant weighed 33.5 g.

The animals were housed in a standard cat cage, 18 × 24 × 30 inches with a stainless steel sleeping compartment, 4 × 4 × 12 inches. In addition to dry cat chow, which is the staple diet of our bushbabies, whole cow's milk (homogenized) and a variety of fresh fruits such as apple, banana, and orange were given daily. The infant was cared for primarily by the mother. When mother and infant moved about the cage, she always carried him in her mouth by the back of the neck. The infant was only observed to cling to the mother when nursing.

The infant was in the sleeping compartment during most of the first week in the laboratory, except for rare occasions when he was with the mother in the larger cage. On April 15, independent activity was first observed. The infant drank milk and took some fresh banana on May 1. Weaning occurred during the next week and the infant was not observed nursing after May 10. Sauer and Sauer (1963) report that independent activity is observed at two weeks and weaning at four weeks. It thus appears that this infant was born around April 1. The growth record of the infant is shown in Figure 1.

A drop in weight occurred at the time of weaning. A variety of commercially prepared baby foods were offered and the weight gain resumed at the previous rate. On June 5 a precipitous weight loss was noted which continued until the infant's death on June 12. The cause of death is not known.

The mother of this infant gave birth again in the first week of July, 1970.

A hand-reared infant.--On February 6, 1970, a male infant bushbaby was discovered with a pair that had been in this laboratory for two

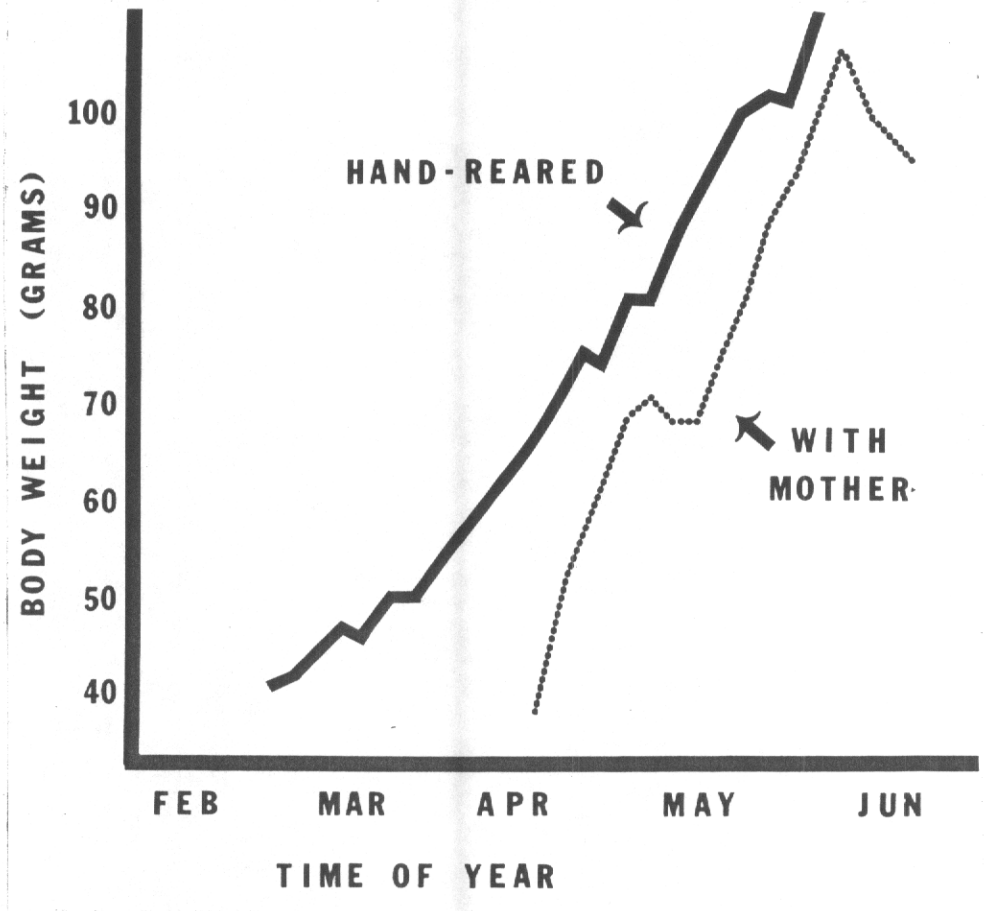


Figure 1. Rate of growth of two captive-born bushbabies. Note that weight gain of the infant with mother was more rapid initially. The first weight loss of the infant with mother represents the period of weaning; the second, preceded the unexplained death of this infant.

years. The mother had been in daily behavioral testing in a shock-avoidance experiment throughout her unsuspected pregnancy. The absence of behavioral or overt morphological signs of pregnancy in *G. senegalensis moholi* has been reported by Doyle, Pelletier, and Bekker (1967). However, it is particularly interesting that daily exposure to moderate levels of electric shock and the stress of behavioral testing throughout the course of pregnancy had no discernable effect on the mother or infant. Both were apparently in good health at all times and the mother showed normal patterns of care for the infant such as nursing, grooming, and carrying. The behavioral testing was terminated on January 12 and the infant was born between this date and February 6.

Because of the previous experience with the infant described above and in order to facilitate observation of development, this infant was taken from the mother on February 24, at which time he weighed 41 g. Initially, the infant was housed in a small cage, 18 × 15 × 9 inches, furnished with a towel-covered heating pad. Later when the infant became more active, he was moved to a larger cage, 22 × 23 × 15 inches, and given a sleeping compartment. At this time he weighed 50 g.

For the first feeding, diluted condensed milk and strained bananas in water were offered by eye dropper and in a dish. Both milk and bananas were accepted only by dropper on the first occasion, but within three days all food was being taken from the dish. A mixture of equal parts of egg yolk, commercially prepared infant cereal, evaporated milk, strained bananas and water with three drops of multiple-vitamins was the staple diet. This mixture was accepted readily. Whenever the infant ate poorly a few drops of honey or corn syrup were added to stimulate his appetite.

The first two days away from the mother, it was necessary to feed the infant every four hours, but by February 27 four feedings a day at 2:00 a.m., 8:00 a.m., 5:00 p.m., and 9:00 p.m. were adequate. For the convenience of the observer, the feedings were gradually shifted to 7:00 a.m., 1:00 p.m., 5:00 p.m., and 11:00 p.m. An analysis of food intake over the first three weeks showed that 66% of feedings between 9:00 p.m. and 4:00 a.m., 54% between 1:00 and 8:00 p.m., and 43% between 5:00 a.m. and 12:00 noon were rated good to very good. Lettuce and fresh fruit, such as pear and apple, were gradually accepted; mealworms and raisins were readily accepted on first offering. Cat chow, moist or dry, has been refused to the present.

A daily record was kept of the infant's growth (Figure 1) and a play period each evening of 20 to 60 minutes was the occasion for observation of behavioral development. When he weighed 41 g, the infant was able to cling, climb, walk and jump on four limbs. On March 8, when he weighed 47 g, he was first observed to stand on hind legs alone and jump. The excellent jumping ability of the adult of this species has been recorded (Hall-Craggs, 1965). This ability appears early in development. By the time he weighed 52 g, kangaroo-like hops had become the preferred mode of locomotion. When he weighed 50 g, a horizontal jump, one foot in length, was recorded; at 52 g, he was able to jump two feet; and by May 13, at 100 g, he was easily able to leap eight feet.

The first occasion of other behaviors typical of the adults of this species was also recorded. Urine-marking of the hands was observed on March 10 when he weighed 47 g. Boxing with the hands while standing erect on the hind legs, an adult aggressive posture, did not appear until April 28 when he weighed 81 g.

This hand-reared bushbaby is presently 7 months old and in excellent

health. Our experience has been that hand-rearing an infant bushbaby is a simple process with few difficulties. Although the rate of weight gain was somewhat slower for the hand-reared infant than for the nursing infant, there is no evidence at present that this was detrimental to the animal. Hand-rearing has the advantage of removing the infant from sources of injury or disease that may possibly be encountered with the parents in the colony homecage.

REFERENCES

Doyle, G. A., Pelletier, A., & Bekker, T. Courtship, mating and parturition in the lesser bushbaby (*Galago senegalensis moholi*) under semi-natural conditions. *Folia Primatologica*, 1967, *7*, 169-197.

Hall-Craggs, E. C. B. An analysis of the jump of the lesser galago (*Galago senegalensis*). *Journal of Zoology*, 1965, *147*, 20-29.

Napier, J. R., & Napier, P. H. *A handbook of living primates*. New York: Academic Press, 1967.

Sauer, E. G., & Sauer, E. M. The South West African bushbaby of the *Galago senegalensis* group. *Journal of the South West Africa Scientific Society, Windhoek*, 1963, *16*, 5-36.

* * *

PSEUDOHERMAPHRODITIC RHESUS MONKEY AVAILABLE

We have found what appears to us to be a female pseudohermaphrodite rhesus monkey (*Macaca mulatta*) in our primate colony. She is 3 to 3-1/2 years old and weighs 3.9 kg. She has been in our colony for one year and appears quite healthy. Because we cannot use her in our toxicity studies, we are offering her to someone who might be able to use her in his research.--Contact Dr. William J. Shirey, or Dr. Peter J. DeBaecke, E. R. Squibb & Sons, Inc., Georges Road, New Brunswick, New Jersey 08903. (Telephone: 201 545-1300, extension 2382)

BASAL HEART RATE IN RHESUS MONKEYS

Joseph M. Stinson and Howard P. Smith

6571st Aeromedical Research Laboratory

Holloman AFB, New Mexico 88330

Values given in the literature for normal heart rates in rhesus monkeys (*Macaca mulatta*) vary widely. The most consistent finding is that rates are lower in anesthetized (Hamlin, Robinson, Smith, & Marsland, 1962) than in unanesthetized (Atta & Vanace, 1960; Malinow, 1966; Stinson & Mattsson, 1970) animals. Indeed, one paper reports specifically that pentobarbital sodium reduces heart rate in rhesus, although the extent of reduction is not given (Atta & Vanace, 1960).

A recent series of experiments in this laboratory requiring that six unanesthetized rhesus[1] be completely isolated in an environmental chamber for 72 hours afforded the opportunity to record basal heart rates. Mean body weight was 5.7 kg (range: 4.4-6.8 kg). Animals were seated in Foringer-type restraint chairs throughout the period, with free access to food and water. Lights inside the chamber were turned off from 9:30 p.m. until 7:30 a.m. Heart rate was determined from the electrocardiogram monitored with suture electrodes, and recorded on a Sanborn 350 recorder.

Heart rate immediately after closing the chamber door varied from 170 to 225 beats/minute with a mean value of 193 (Table 1). During the

Table 1

Heart Rate at Eight Hour Intervals

Hour	Chamber Lights	Mean	Standard Deviation	Range
0	On	193	20.3	170-225
8	On	143	21.5	105-175
16	Off	132	13.1	120-160
24	On	147	21.0	115-175
32	On	147	20.6	105-170
40	Off	131	16.7	110-155
48	On	150	11.9	130-165
56	On	139	29.6	95-165
64	Off	128	15.5	95-140
72	On	143	30.6	100-195

[1]The animals used in this study were handled in accordance with the "Guide for Laboratory Animal Facilities and Care" issued by the National Academy of Sciences--National Research Council.

following 72 hours, the range for heart rate was 90-195 with a mean of 140 beats/minute. The lowest values were recorded while chamber lights were out, ranging from 90 to 143 beats/minute. Sinus arrhythmia was observed in three of the animals at some time during the period of observation, and sporadic premature ventricular contractions occurred in one of these.

The values reported here for heart rate are considerably lower than those previously given for unanesthetized rhesus monkeys (Atta & Vanace, 1960; Malinow, 1966; Stinson & Mattsson, 1970). This could very likely be related to the fact that in these cited studies, animals were physically restrained in the supine position, a technique which probably stimulates the sympatho-adrenal system. While heart rate could not be definitely related to sleep in this study, lower rates through the night when the chamber was dark than during the day when the chamber was lighted suggest such a relationship.

REFERENCES

Atta, A. G., & Vanace, P. W. Electrocardiographic studies in the *Macaca mulatta* monkey. *Annals of the New York Academy of Sciences*, 1960, *85*, 811-818.

Hamlin, R. L., Robinson, F. R., Smith, C. R., & Marsland, W. P. Heart sounds of healthy *Macaca mulatta*. *Journal of Applied Physiology* 1962, *17*, 199-200.

Malinow, M. R. An electrocardiographic study of *Macaca mulatta*. *Folia Primatologica*, 1966, *4*, 51-65.

Stinson, J. M., & Mattsson, J. L. Tolerance of rhesus monkeys to graded increase in environmental CO_2: serial changes in heart rate and cardiac rhythm. *Aerospace Medicine*, 1970, *41*, 415-418.

* * *

REQUEST FOR PRIMATE CADAVERS

Frozen or preserved cadavers of Asian and African Colobinae, that is langurs (*Presbytis*) and guerezas (*Colobus*), and also of Indriidae, that is indrises (*Indri*), avahis (*Avahi*), and Sifakas (*Propithecus*) are needed for research of the hyoid apparatus.--Dr. R. A. Hilloowala, Dept. of Anatomy, West Virginia University Medical Center, Morgantown, W. Va. 26506.

CORRESPONDENCE

ON THE BREEDING OF MARMOSETS AND TAMARINS

Sir: With reference to the very interesting article in the April, 1970, *Newsletter* on the golden marmoset, I am very pleased to hear that efforts are being made to breed them at the San Diego Zoo but sorry to hear that they are not having a great deal of success to date. We have been breeding five species of marmosets and tamarins (*Callithrix jacchus*, *C. argentata*, *Saguinus oedipus*, *S. nigricollis*, and *Cebuella pygmaea*) here for the past five years and after considerable experimentation with various systems of feeding and housing have now got them breeding regularly and rearing the young with relatively little difficulty. I thought that possibly some of our observations, which I have described in greater detail elsewhere (Kingston, 1970), might assist with Leontideus, although we have not been able to get a pair of this species and in view of the conservation need are unlikely to do so.

Our breeding pairs have been selected at random from imported stock after the animals have been in our laboratory for 6 to 12 months. All such pairs, numbering 27 in all, have bred and, in most cases, reared their young uneventfully in quite small simple cages under generally very simple conditions. The main secret is in my opinion the need for the animals to have a full sense of security both of territory and personnel. This takes time to establish and the most important single factor is that they should be kept in the same cage in the same position in the same room. The design of the cages, which have a solid back, sides, and top, and only the front of mesh, does, I feel, increase the sense of security which I consider so essential. While it is obvious that reasonable hygiene must be maintained, it is definitely unwise to be continually changing the cage and the nest box. The too lavish use of strongly smelling disinfectants and detergents may possibly destroy the odors which mark the animals' territories. It is also advisable that the animals be looked after by the same attendant since it is quite obvious that they recognize personnel and are disturbed by strangers.

With regard to diet, we have tried a wide range of the published suggestions and have found that the diet suggested by Levy and Artecona (1964) with the addition of apple, banana and grapes has kept the original breeding pairs, which we have now had almost five years, in very good condition. The cage-bred young are in most cases larger and finer than their wild-caught parents. We found out the importance of vitamin D_3 the hard way when our very first set of twins became rachitic at three months old in spite of the high level of D_2 in the diet. We now feed orally 2,500 I.U. D_3 in arachis oil fortnightly and have not only had no more cases of rickets but also noted a marked improvement in their breeding performance. The only other supplements

are a water soluble vitamin supplement (Abdec, Parke Davis) given twice weekly in the drinking water and a B12 syrup (Cytacon, Glaxo) given once weekly.

I realize that the golden marmoset is a different species with which I have had no experience whatsoever, but the whole family of marmosets and tamarins is so very homogeneous it would seem unlikely that it would differ much in its requirements from the five species we have. The golden marmoset is the largest species but very little larger than cotton tops (*Saguinus oedipus*). Although we breed the latter quite successfully in our cages, I do think they are a little small for them, so perhaps the cages should be larger for golden marmosets. I have no doubt that other people would disagree with these suggestions, but they are offered for what they are worth because I consider that no effort should be spared to try and ensure the continued survival of this most attractive and spectacular primate species.

REFERENCES

Kingston, W. R. Marmosets and tamarins. In F. T. Perkins & P. N. O'Donoghue (Eds.), *Laboratory animal handbooks*. No. 4: *Hazards of handling simians*. London: Laboratory Animals Ltd., 1969. Pp. 243-250.

Levy, B. M., & Artecona, J. The marmoset as an experimental animal in biological research. Care and maintenance. *Laboratory Animal Care*, 1964, *14*, 20.

W. R. Kingston,
Chief Animal Technician
Fisons Limited, Pharmaceutical Division
Dodgeford Lane, Belton, Loughborough
Leicestershire, England

SPECIES OF NONHUMAN PRIMATES IN THE REGIONAL PRIMATE RESEARCH CENTERS IN THE UNITED STATES

William J. Goodwin

Animal Resources Branch, Division of Research Facilities and Resources

National Institutes of Health, Bethesda, Maryland 20014

During their five to seven years of operation, the seven Regional Primate Research Centers have developed extensive research programs using a variety of nonhuman primates as experimental animal models. The species and numbers of nonhuman primates used for research purposes has increased significantly both in the primate research centers and in other primate laboratories. In a recent report, Goodwin (1970) presented data on the number of projects using nonhuman primates, the agencies supporting the research activities, and the species most commonly employed.

The primate research centers collectively have one of the largest and most varied collection of nonhuman primates found anywhere in the world. Statistics recently compiled on the species and numbers available in the seven centers are shown in Table 1. These data indicate a total of 7,672 nonhuman primates, representing 8 families, 29 genera, and 57 species.

In general, the centers have identified special areas of research (Table 2) and have concentrated on developing one or more species with physiological or behavioral characteristics that make them uniquely suited for the various research programs. At the Oregon Center, *Macaca mulatta* is being used extensively in reproductive biology research and *Macaca fuscata* for behavioral studies; in addition, an excellent colony of prosimians belonging to the genus *Lemur* has been developed. *Macaca nemestrina* is the species of choice at the Washington Center. These primates are especially suitable for cardiovascular physiology, neurophysiology, and orthodontic investigations. The patas monkey, *Erythrocebus patas*, has been used for a number of studies at the Delta Center, including some on viral hepatitis. A colony of *Callimico goeldii* is also available for behavioral studies at this Center. *Macaca mulatta* has been used extensively in behavioral studies at the Wisconsin Center for a number of years. The Yerkes Center is devoted to studies on the anthropoids, including *Pan troglodytes*, *Pongo pygmaeus*, and *Gorilla gorilla*, in the areas of psychobiology, immunology, and reproductive biology research. Infectious diseases research is one of the major programs of the New England Center and New World monkeys have proven ideal for a number of these studies. The National Center for Primate Biology has as its mission the study of primate biology. Currently, normal baseline studies are being conducted on five species of the genus *Macaca* and several other species. Additional information regarding the scientific programs and the species employed may be obtained by contacting the primate research centers directly (Table 2).

Table 1

Distribution of Nonhuman Primates in the Regional Primate Research Centers

Jan. 1 to Dec. 31, 1969

Species	Center							Total
	Ore.	Delta	Yerkes	Wash.	Wis.	N.E.[a]	Nat.[b]	
PROSIMII								
Tupaiidae								
Tupaia glis	--	--	--	--	--	16	--	16
Lemuridae								
Lemur catta	28	--	3	--	--	--	--	31
Lemur macaco	9	--	1	--	--	--	--	10
Lemur m. fulvus	41	--	--	--	--	--	--	41
Lemur mongoz	11	--	--	--	--	--	--	11
Microcebus murinus	1	--	--	--	--	--	--	1
Lorisidae								
Arctocebus calabarensis	1	--	--	--	--	--	--	1
Galago crassicaudatus	81	--	--	--	--	--	--	81
Galago senegalensis	--	--	--	--	--	12	--	12
Nycticebus coucang	11	--	--	3	--	2	--	16
Perodicticus potto	13	--	--	--	--	--	--	13
ANTHROPOIDEA								
Callithricidae								
Callimico goeldii	--	13	--	--	--	--	--	13
Callithrix geoffroyi	--	--	2	--	--	--	--	2
Cebuella pygmaea	--	--	--	--	4	--	--	4
Saguinus oedipus	--	--	--	--	--	25	--	25
Cebidae								
Aotus trivirgatus	1	5	3	--	--	73	--	82
Ateles geoffroyi	--	--	3	--	--	--	--	3
Ateles paniscus	--	--	3	--	--	--	--	3
Callicebus moloch	--	44	--	--	--	--	--	44
Callicebus torquatus	--	4	--	--	--	--	--	4
Cebus albifrons	--	2	--	1	--	31	--	34
Cebus apella	--	2	--	--	--	5	--	7
Cebus capucinus	--	--	9	--	--	2	--	11
Lagothrix lagothricha	--	--	--	--	--	2	--	2
Saimiri sciureus	103	47	149	12	32	117	--	460

Species	Center							Total
	Ore.	Delta	Yerkes	Wash.	Wis.	N.E.[a]	Nat.[b]	
Cercopithecidae								
Cercocebus albigena	--	1	--	--	--	--	--	1
Cercocebus aterrimus	--	--	--	--	--	2	--	2
Cercocebus atys	--	--	27	--	--	--	100	127
Cercocebus galeritus	--	1	--	--	--	--	--	1
Cercopithecus aethiops	--	8	16	--	--	--	70	94
Cercopithecus albogularis	--	--	--	--	--	1	--	1
Cercopithecus cephus	--	--	2	--	--	--	--	2
Cercopithecus mitis	--	--	2	--	--	--	--	2
Cercopithecus talapoin	--	37	7	--	--	--	--	44
Cynopithecus niger	41	--	22	--	--	--	--	63
Erythrocebus patas	--	129	3	--	--	--	--	132
Macaca arctoides	23	28	13	4	105	46	94	313
Macaca cyclopis	--	--	--	39	--	76	--	115
Macaca fascicularis	78	14	58	57	--	53	257	517
Macaca fuscata	87	--	--	14	--	--	--	101
Macaca maura	--	--	6	5	--	2	--	13
Macaca mulatta	1169	184	234	163	739	266	976	3731
Macaca nemestrina	67	--	56	457	20	11	113	724
Macaca radiata	--	--	7	--	--	--	257	264
Mandrillus leucophaeus	--	--	5	--	--	--	--	5
Mandrillus sphinx	--	--	4	--	--	--	--	4
Papio anubis	--	--	--	97	--	--	--	97
Papio hamadryas	--	1	--	--	--	9	--	10
Papio papio	--	83	1	--	--	4	35	123
Presbytis entellus	--	--	--	--	--	--	45	45
Theropithecus gelada	--	--	12	--	--	--	--	12
Hylobatidae								
Hylobates lar	--	2	6	--	--	--	--	8
Hylobates l. pileatus	--	1	--	--	--	--	--	1
Symphalangus syndactylus	--	--	1	--	--	--	--	1
Pongidae								
Gorilla gorilla	--	--	15	--	--	--	--	15
Pan troglodytes	--	58	82	--	--	4	--	144
Pongo pygmaeus	--	--	33	--	--	--	--	33
TOTAL 59	1765	664	785	852	900	759	1947	7672

[a]New England Regional Primate Research Center

[b]National Center for Primate Biology

Table 2

Primate Research Centers Supported by NIH

Center	*Major Research Orientation*
Delta Regional Primate Research Center Covington, Louisiana 70433 Director--Dr. Arthur J. Riopelle Telephone: (504) 892-2040	Infectious diseases, reproductive physiology, environmental health, aging, behavioral sciences, pathology.
National Center for Primate Biology University of California Davis, California 95616 Director--Dr. Robert E. Stowell Telephone: (916) 752-0421	Primate biology, reproductive biology, pathology, microbiology, and the establishment of normal biological profiles.
New England Regional Primate Research Center One Pine Hill Drive Southborough, Massachusetts 01772 Director--Dr. Bernard F. Trum Telephone: (617) 481-0400	Microbiology, virology, pathology, physiology, nutrition, and anthropology.
Oregon Regional Primate Research Center 505 N.W. 185th Street Beaverton, Oregon 97006 Director--Dr. William Montagna Telephone: (503) 645-1141	Reproductive physiology and population control. Studies in cardiovascular physiology, cutaneous biology, immunology, neurophysiology, behavioral sciences, and anthropology are also underway.
Regional Primate Research Center University of Washington Room G 404, Health Sciences Bldg. School of Medicine Seattle, Washington 98105 Director--Dr. Theodore C. Ruch Telephone: (206) 543-1430	Cardiovascular physiology, neurophysiology, oral facial growth and development, endocrinology and metabolism, and behavioral sciences.

Center	*Major Research Orientation*
Wisconsin Regional Primate Research Center University of Wisconsin 1223 Capitol Court Madison, Wisconsin 53706 Director--Dr. Harry F. Harlow Telephone: (608) 262-3844	Behavioral studies, giving particular attention to mother-infant relationships. Studies are also being conducted in the areas of mental retardation, psychopharmacology, and psychophysiology.
Yerkes Regional Primate Research Center Emory University Atlanta, Georgia 30322 Director: Dr. Geoffrey H. Bourne Telephone: (404) 377-2411 Extension 7951	Research using the greater apes, including histology, neuroanatomy, immunology, sociobiology, psychobiology, neurophysiology, and pathology.

In summary, the primate research centers, supported by the National Institutes of Health, have a large population of nonhuman primates, representing a number of species, that is being used in a variety of biomedical research projects. In addition, the centers have developed specialized colonies in support of their particular research interests.

REFERENCES

Goodwin, W. J. Current use of nonhuman primates in biomedical research. *Laboratory Animal Care*, 1970, *20*, 329-332.

THE GESTATION PERIOD OF THE POTTO*

H. Butler and M. B. Juma

Department of Anatomy, University of Saskatchewan

Saskatoon, Saskatchewan, Canada

Birth of the potto (*Perodicticus potto*) in captivity is a comparatively rare event and only 13 births have been recorded over the past 20 years (Cowgill, 1969). In no instance was the duration of gestation known but the shortest interval between two successive births was 195 days.

A pair of pottos were received in this laboratory during July, 1969. They were kept in the same cage and daily vaginal smears were begun on September 1, 1969. Sperm were found in the vaginal smear on November 3 and December 13, 1969. On the second finding of sperm the male was removed. Up to the end of December, 1969, the female had an average monthly weight gain of 23 g. During 1970 the monthly gain in weight steadily increased reaching a peak of 56 g in March. By this time the pregnant uterus was easily palpable and the three pairs of nipples were increasingly prominent.

A newly born infant was found on June 1, 1970, giving a gestation period of 170 days. On the fourth day the infant weighed 40 g and by the 106th day it was 532 g. The growth rate of this infant was very similar to that reported by Grand, Duro, and Montagna (1964), who recorded a 10-fold weight increase in 109 days. Although the milk teeth were fully erupted by the 50th day after birth, the infant did not begin to eat solid foods until some 3 weeks later. Until the infant began to eat, the mother showed a marked decline in weight but this is now slowing down.

REFERENCES

Cowgill, V. M. Some observations on the prosimian *Perodicticus potto*. *Folia Primatologica*, 1969, *11*, 144-150.

Grand, T., Duro, E., & Montagna, W. Observations on the development of a potto born in captivity. *American Journal of Physical Anthropology*, 1964, *22*, 329-332.

---

*Supported by Grant No. MA-1833 from the Medical Research Council of Canada.

PRIMATE CHINS*

1. *"Dear Mr. Curator: I have a problem. Do monkeys have chins?"*

Every third grade pupil in Room 3-E, Tinley Heights School, Tinley Heights, Illinois, has that problem, and all want an answer. Each one wrote his question on a sheet of lined school paper, and class teacher, Mrs. D. Walter, sealed all the sheets in one big manilla envelope, and mailed them to Mr. Hershkovitz.

The first letter is a bit vague, but urgent nonetheless.

> *Dear Mr. Curator*
> *We have a proman. Do you know if monkeys have a chin?*
> *If they do will you tell me?*
>
> *from*
> *Dwayne*

The next letter throws more light on the turmoil in Tinley Heights.

> *Dear Mr. Curator*
> *Do monkeys have chins. Thats what I want to know. We saw a movie. It was called the whomen animal. Are we the only ones that has chins?*
>
> *Your freind*
> *Steven M.*

And this one reveals a mysterious female in the case.

> *Dear Mr. Curator*
> *We are wanting to know if monkeys have chins. A girl in our class has two monkeys. Her name is Jackie.*
>
> *Your friend*
> *Crystal*

Kristi goes Crystal one better and makes all clear.

> *We saw a movie about animals. It says monkeys don't have chins. But I want to know if they do. Or if some kinds of monkeys do. A girl in my room has some and said they have chins. So please tell if all or some monkeys have chins.*
>
> *Thank you*
> *Kristi Bistensky*

---

*The following were reprinted from *Bulletin Field Museum of Natural History*, 1970, *41* [5], 6-10.

And Gilbert gives us the inside story on how this search for truth started.

Dear Mr. Curator
Our class doesn't know if a monkey has a chin. The movie said animals don't have chins. But our teacher asked Jacki in class that has a monkey if it has a chin. She said yes it does. Will you write to us and tell us if a monkey has a chin.
From
Gilbert Dy

Other children like Ann Hayward, Billy Pirman, and Gina Tolva, are just as anxious to know, but Joel broadens the issue.

Dear Mr. Curator
Do Gorillas and monkey and Chimpanzs have chins?

And my good friend Robert goes right to the fountainhead.

Dear Mr. Curator
I want to know if the monkey has a chin. Snice you know all about animals. Their is a kid name Jackie has two monkeys but she doesn't [know] so much that you do.
Your freind
Robert Tagliali

This faith in the superior knowledge and wisdom of Mr. Curator is solidly backed by classmates Craig Cooper, Lauri Edwards, Barry Kline, Sherry Miller, Kevin Schultz, Barbara Schutzius, and just plain Tom. Last, but certainly foremost, our charming and disarming little friend Jackie herself, writes:

Dear Mr. Curator
I have two monkeys at home. Do they have chins Mr. Curator. I saw a movie. They say that monkeys don't have chins.
Your friend
Jackie Pedig

2. *The Decorative Chin*

Philip Hershkovitz
Field Museum of Natural History
Chicago, Illinois 60605

Yes Jackie. Your monkeys, indeed all monkeys, and chimpanzees and gorillas, too, have chins. Here is what Webster's Third New International Dictionary of the English Language, Unabridged, has to say about CHIN. "1: the lower portion of the face lying below the lower lip and including the prominence of the lower jaw and the overlying soft tissues. 2: the surface lying beneath the lower jaw or be-

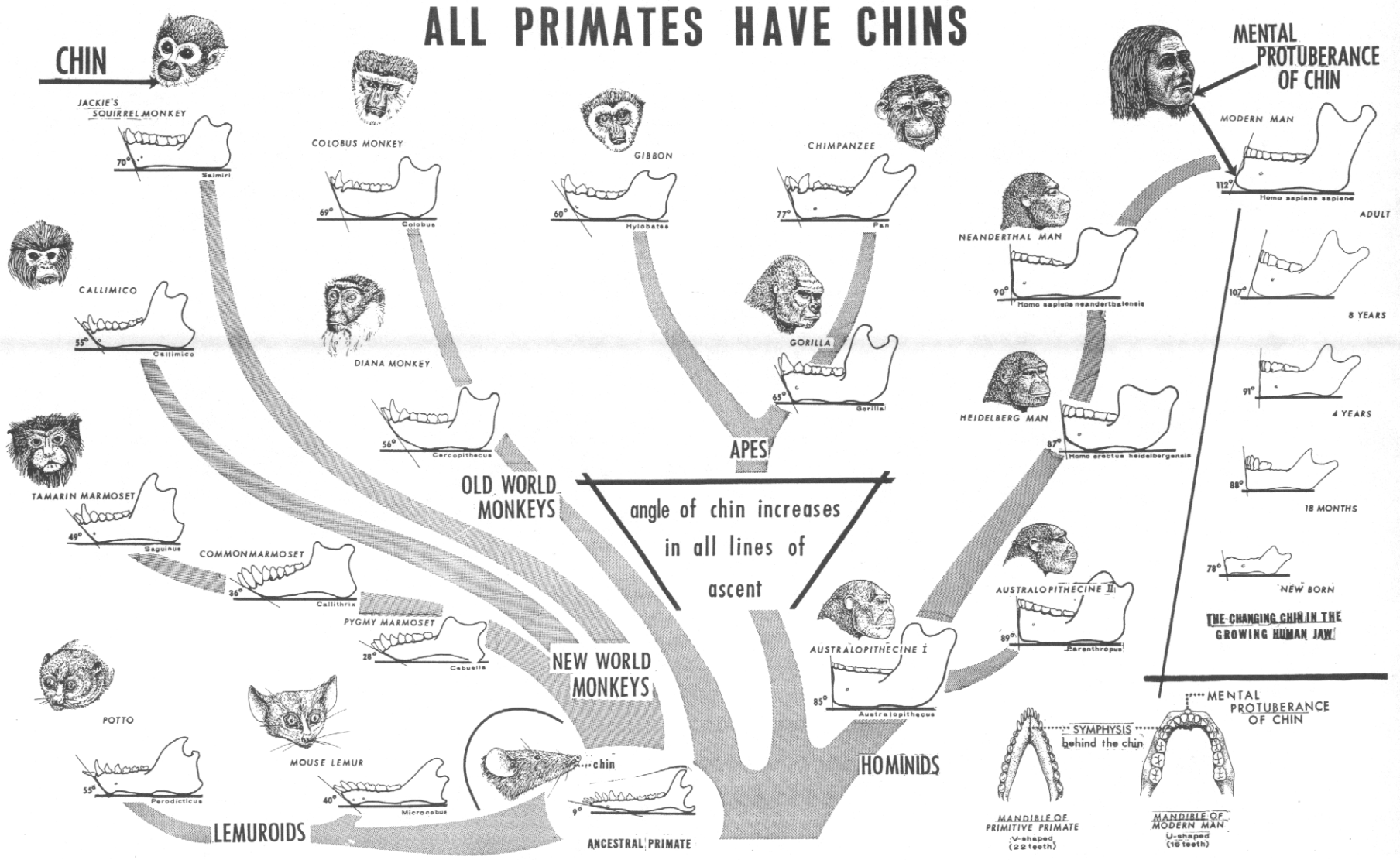
tween the branches of the jaw--used chiefly of lower vertebrates in which a mental prominence is lacking from the jaw bone."

By either definition, monkeys have chins--as do all animals with lower jaws. The human chin, however, differs from that of monkeys and all other animals in one respect, at least. It has a bump in front that makes it jut out. This is the mental prominence, or mental protuberance, mentioned in the dictionary's definition. Unfortunately, some writers on human anatomy and evolution, and the producers of the movie seen by the children, fail to distinguish between the chin which is present in all animals with lower jaws, and the mental protuberance which is a *special part* of the human chin. The word "mental" used here is a technical term from the Latin *mentum* meaning chin (or beard). The English word mental referring to the mind or intelligence, derives from the entirely different Latin word *mens*. In this case, it seems, a little mental protrusion causes a great deal of mental confusion.

Just how humans came by that mental protuberance, or jutting jaw, is a long, and perhaps still untold story. The ancestor of man, and of all primates, was a tiny, long-snouted creature no larger than a small mouse. It had separate right and left lower jaw bones which met in a loose joint in front called the symphysis. The front of the joint, or chin, was nearly in line with the base of the jaw. That is to say, the angle of the chin was hardly 10°. Among earliest primates such as lemurs and tarsiers, the two branches of the lower jaw or mandible remained separate but fitted together into a chin which formed a low but distinct angle with the base line of the mandible. As the different families of monkeys, apes and man began to evolve, the jaw became shorter and its right and left branches fused into a single bone forming a steep chin. All this change was correlated with reduction in length of the ancestral muzzle, the movement of the eyes from the sides of the head to the front, and the use of the hands for bringing food to the mouth. With the changing diet, from mainly insectivorous to mainly herbivorous, the mouth became shorter and more rounded in outline, the number of teeth fewer with less space between, and the chin steeper and broader.

Among the families of New World monkeys, the marmosets are the most primitive, and the angle of their chin averages from 28° in the pygmy marmoset to 49° in tamarins. In the more advanced marmoset-like *Callimico*, the angle averages 55°, and in squirrel monkeys and ring-tailed monkeys, the angle of the chin averages higher with the extreme nearly 75°. In Old World monkeys like guenons, macaques, and langurs, the angle of the chin is sometimes nearly as high, but in most apes it is higher. In one chimpanzee measured, the angle is 77°, in another it is 80°. In none of these is a distinct mental protuberance present, but a rudiment may appear occasionally in any species of monkey or ape.

The ape-men, or australopithecines, of Africa and Java, lived


ALL PRIMATES HAVE CHINS
CHIN
JACKIE'S SQUIRREL MONKEY
70°
Saimiri
COLOBUS MONKEY
69°
Colobus
GIBBON
60°
Hylobates
CHIMPANZEE
77°
Pan
MENTAL PROTUBERANCE OF CHIN
MODERN MAN
112°
Homo sapiens sapiens
ADULT
NEANDERTHAL MAN
90°
Homo sapiens neanderthalensis
107°
8 YEARS
CALLIMICO
55°
Callimico
DIANA MONKEY
56°
Cercopithecus
GORILLA
65°
Gorilla
91°
4 YEARS
HEIDELBERG MAN
87°
Homo erectus heidelbergensis
APES
OLD WORLD MONKEYS
88°
18 MONTHS
TAMARIN MARMOSET
49°
Saguinus
COMMONMARMOSET
36°
Callithrix
angle of chin increases in all lines of ascent
78°
NEW BORN
THE CHANGING CHIN IN THE GROWING HUMAN JAW
PYGMY MARMOSET
28°
Cebuella
NEW WORLD MONKEYS
AUSTRALOPITHECINE II
89°
Paranthropus
AUSTRALOPITHECINE I
85°
Australopithecus
POTTO
55°
Perodicticus
MOUSE LEMUR
40°
Microcebus
chin
9°
ANCESTRAL PRIMATE
HOMINIDS
LEMUROIDS
SYMPHYSIS behind the chin
MENTAL PROTUBERANCE OF CHIN
MANDIBLE OF PRIMITIVE PRIMATE
V-shaped
(22 teeth)
MANDIBLE OF MODERN MAN
U-shaped
(16 teeth)

about 2,000,000 to 750,000 years ago. These earliest of human-like creatures walked erect, and used sticks, stones and bones for tools. Their chins were well formed, verged on the vertical, but lacked a protuberance. The first man, *Homo erectus*, appeared over one-half million years ago in Europe, Asia, and Africa. His chin, as seen in the mandible of Heidelberg man, was strong and angular, but fell even shorter of the vertical than did the chin of some ape-men. In none of these forerunners of man was the jaw receding or "chinless" as generally shown in artistic reconstructions of the face.

The first race of man belonging to our species, *Homo sapiens*, arose between 300,000 and 250,000 years ago, and spread rapidly throughout Asia, Africa and Europe. The angle of the chin of these Neanderthal types was steeper than that of Heidelberg man, but still less than vertical. In more highly evolved Neanderthals the chin attained, and even surpassed, 90°, and a mental protuberance began to appear as a well-marked feature. However, not until the end of the Pleistocene, and the early part of our own era, between 25,000 and 35,000 years ago, did the jutting jaw with an angle exceeding 90° arise as a distinguishing human character. The back of the human chin, or posterior symphysis, is also peculiar with the broad, bony shelf of most nonhuman primates replaced by an everted bony area supporting spines for the attachment of tongue muscles.

The possible function of the mental protuberance has been a favorite subject for speculation. It has been suggested that the protuberance braces the two branches of the lower jaw against the constructing force of the external pterygoid muscles. Early races of man, however, with more powerful muscles, managed to keep their jaws braced without the aid of a protuberance. Furthermore, bony struts, braces, and reinforcements, some known as simian shelves, others as mandibular tori, are extremely variable in structure, and none is consistently present in any one primate species.

A noted anatomist argued that the rate of growth and eruption of the teeth caused the alveolar or tooth socket portion of the jaw to be shorter than the basal part, hence the protuberance near the base. There is no evidence, however, that dental growth and succession in modern man differs consistently from that of earlier species of man or even of ape-men, all without the protuberance.

It has been proposed that the shape of the chin is fashioned by the muscles of speech. Such muscles, however, would affect the inner, not the outer, surface of the symphysis. In any case, earliest man inherited all the properties and potentials of speech from his mammalian ancestor, or from an even earlier vertebrate ancestor, as any parrot or myna bird can testify. The significant factors controlling the evolution of rational speech, however, lie in the nervous tissue, and not in the organs of vocalization. *Homo erectus*, judged by what is known of his culture, was certainly a talker. Even the ape-

man, *Australopithecus*, must have been capable of speech. Neither of these hominids had our kind of chin. It has also been advanced that fetalization, or the retention of fetal characters in the adult, accounts for the mental protuberance. If anything, the contrary should be true. The chin of the human fetus, newborn, and toddler, is more monkey or ape-like than human.

A good deal has been said about the evolution of the human type of chin as part of the adaptation of the human body to the upright position and bipedal locomotion. There is absolutely no relationship between the two events. Man-like posture and gait had been perfected long before the appearance of the mental protuberance. Furthermore, the poise and movement of the head are controlled by its articulation with the spine, and by the action of neck muscles which have nothing to do with the jaws.

Finally, a distinguished professor of anthropology and author of a textbook, using less prudence than would Tinley Heights third graders, borrowed from a dubious source, the statement that if the human mandible had not changed, it would have constricted the windpipe, larynx, and soft parts of the neck including the vital veins and arteries leading to and from the brain! This dire and fantastic hypothesis ignores the basic fact that growing bone accommodates or yields to the soft tissues which are laid down first. The reverse is never true.

The mental protuberance is a superficial character which arose very late in the evolution of man. It is devoid of any physical function. It evolved in a way and in a place without apparent structural relationship to the mouth or to any other part of the body. The protuberance is, nevertheless, a consistent, distinctive, and very conspicuous human trait. The female chin with its protuberance is bare, smooth, often dimpled, shapes the face, and owns a natural charm and appeal which is rarely if ever altered or heightened by cosmetics. The jutting aggressive chin of the human male must have always been kept bare, by plucking, if necessary, until long after puberty and mating when the beard, if any, would begin to come in full as a sign of senior masculinity. The mental protuberance may be compared with such highly attractive facial features as long head hair, the expansively bare forehead, the raised cheek bones, the variable shape and color of the eyes and lips, and the decorative eyebrows. None of these can claim any biomechanical function. Like them, the mental protuberance appears as a badge of recognition, and as a lure and stimulant to mating. In males, particularly, the pointed chin also accentuates gestures of defiance, and in females, lends eloquence to expressions of haughtiness or petulance. Natural selection favored rapid spread of the mental protuberance until it became universally established as an ornament of the chin unique to modern man.

MONKEY EEG TELEMETRY: AN APPARATUS FOR ATTACHING EXTERNAL EQUIPMENT

Glenn Morrison and John A. Santolucito

Division of Pesticide Chemistry and Toxicology

Bureau of Foods and Pesticides, Public Health Service

Perrine, Florida 33157

In many electroencephalographic (EEG) studies of nonhuman primates it is desirable to obtain the data from an awake, unrestrained animal. Biomedical telemetry techniques have been developed which facilitate this approach (MacKay, 1968); however, these techniques are not without inherent problems (Ruch & Spelman, 1969). One of these problems relates to mounting a telemetering device on an unrestrained primate. Such an animal can normally reach and damage this type of equipment.

Various backpack and headgear devices have been developed and successfully used for prolonged recording (Delgado, 1969; Schwartz, Eidelberg, & Cheshire, 1967; Van Citters & Franklin, 1969). However, these are unsuitable for experiments involving short intervals of recording and when frequent transfers of equipment from animal to animal are required. This report deals with a solution to this problem.

Rhesus monkeys (*Macaca mulatta*), weighing from 3 to 4 kg, have been fitted with chronic brain implants of Teflon-coated platinum electrodes (depth and surface). These electrodes are attached to an Amphenol 12-contact Micro-Mod connector (96-3) which is fitted with four 000-120 × 3/8 inch stainless steel machine screws and cemented to the skull with cranioplastic cement (Anschel, 1967). This connector is shown in Figure 1.

If the connector is left unprotected, the more obstreperous monkeys will destroy it. Therefore, we have designed and had fabricated[1] a protective covering device. This anodized aluminum head-plug-cover assembly consists of two parts, a base or mounting ring and a cover. The base (Figures 2 and 3) has three legs and is circumferentially grooved and notched so that the cover (Figure 2) can be attached and secured with a quarter turn (bayonet lock). The cover is further secured with a set screw. The head-plug-cover assembly mounted on the animal is shown in Figure 4.

When an EEG is to be obtained from a monkey, a single channel FM transmitter connected to a male Amphenol connector plug is placed in a

---

[1]By Mr. E. A. Favre, Small Parts, Inc., 6901 N.E. 3rd Avenue, Miami, Florida 33138.

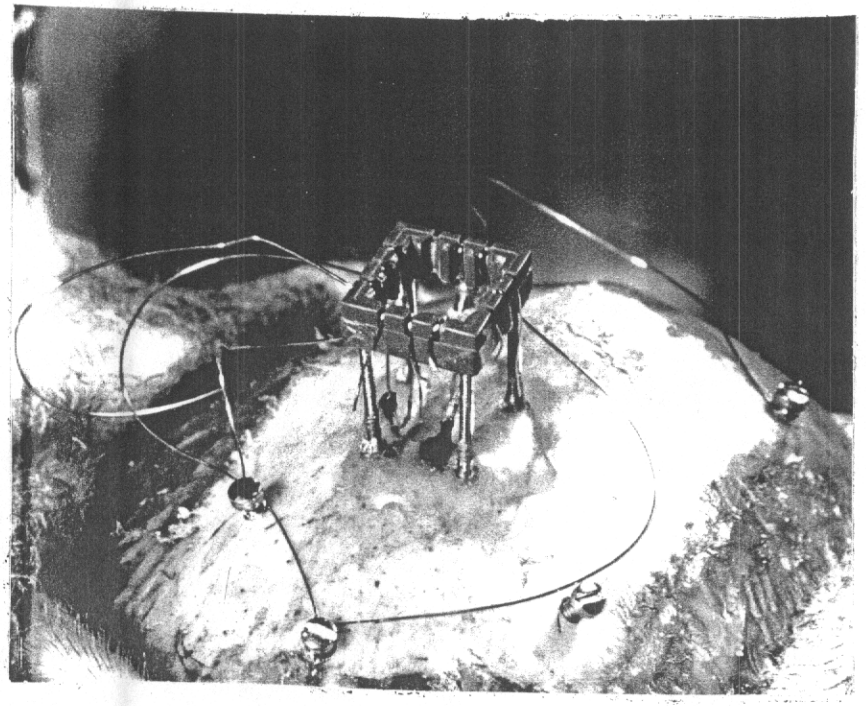


Figure 1. A modified Amphenol 96-3 Micro-Mod connector cemented to the skull.

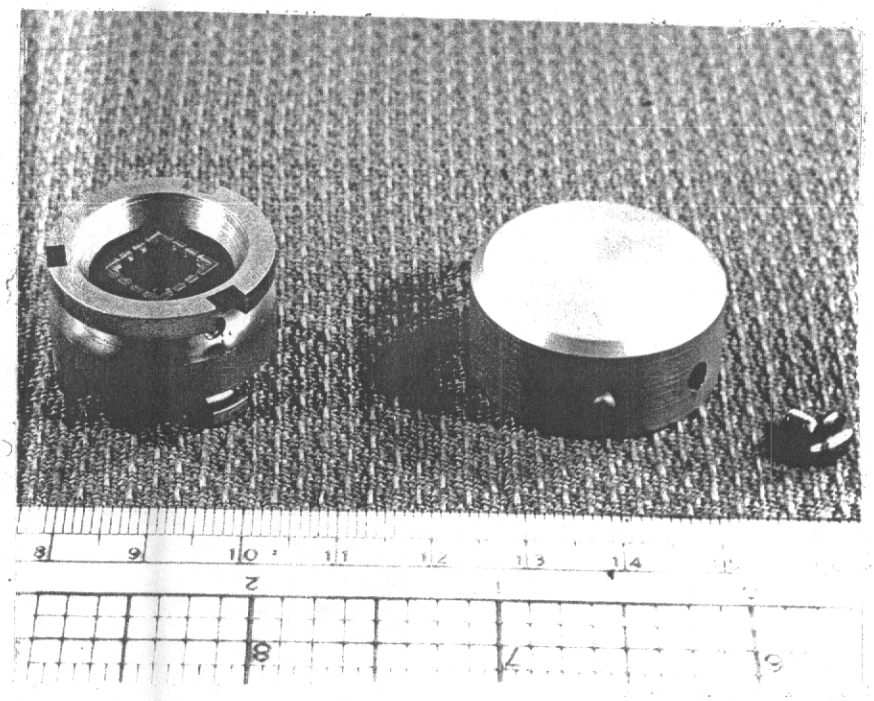


Figure 2. The components of the head plug assembly, showing the Amphenol connector within the base or mounting ring, the protective cover, and the locking screw. The ruler at the bottom of the photograph indicates the size of the components.

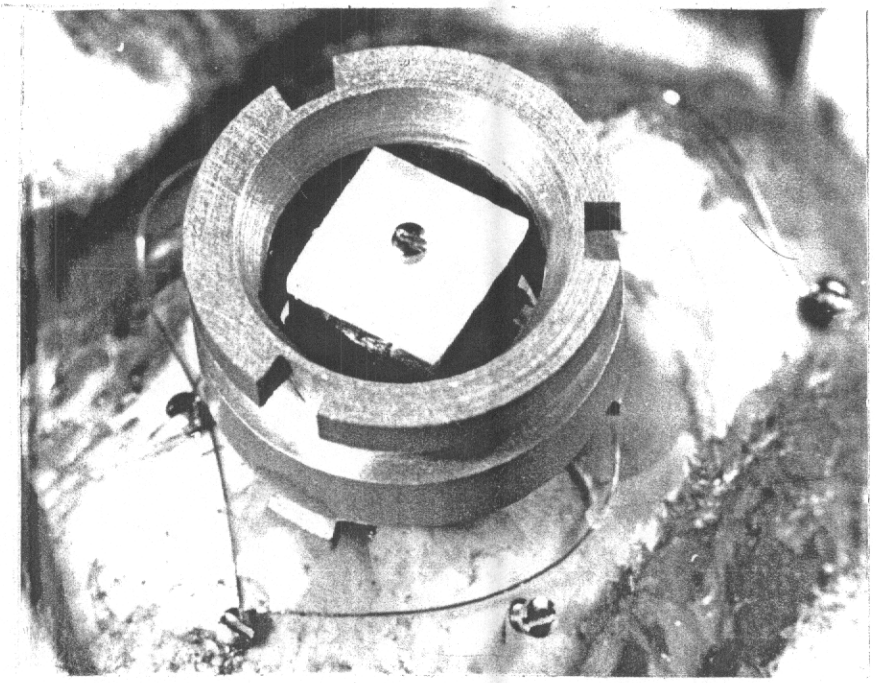


Figure 3. The base or mounting ring of the head-plug-cover assembly cemented to the skull enclosing an Amphenol connector fitted with a Sylastic male plug.

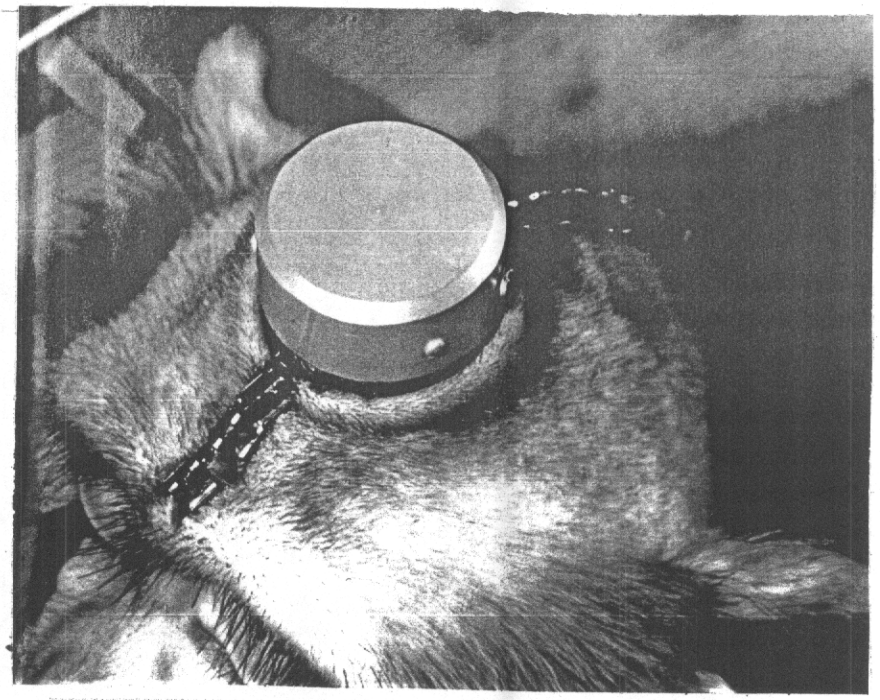


Figure 4. The head-plug-cover assembly mounted on the animal.

specially designed anodized aluminum cylinder which can then be attached directly to the skull-mounted base with the same bayonet lock arrangement. The components of this transmitter container assembly and the transmitter are shown in Figure 5. The antenna is protected with a tapering (9/16 to 5/16 inch) open-ended nylon tube screwed into the removable top of the transmitter holder. The transmitter container assembly attached to the animal is shown in Figure 6. The assembly is further secured with a recessed hex screw which can also be seen in Figure 6.

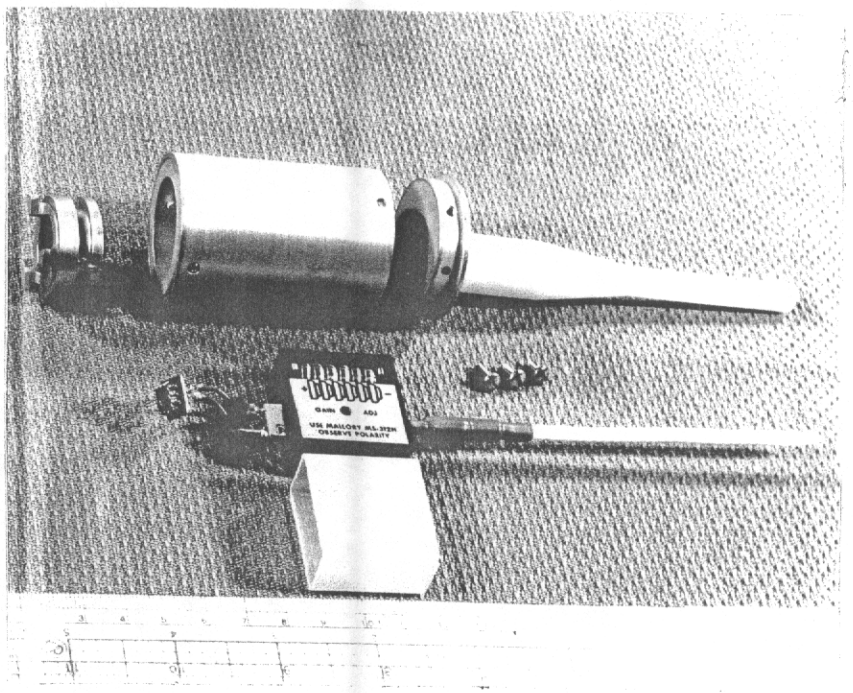


Figure 5. The components of the transmitter container assembly are shown at the top of the photograph. From left to right at the top is the base, the cylinder in which the transmitter is placed, and the nylon antenna protector. Below, there is an onyx transmitter attached to the Amphenol male plug connector. The plastic fitting just above the ruler is a cover for the transmitter.

The whole operation of affixing the transmitter to the animal takes only a few seconds and the monkey can then be released to move freely within the transmitter's reception area with all equipment fully protected.

This apparatus has proved valuable in our hands and allows the rapid, efficient use of a few transmitters for many experimental animals. We believe it may be of value to others as well.

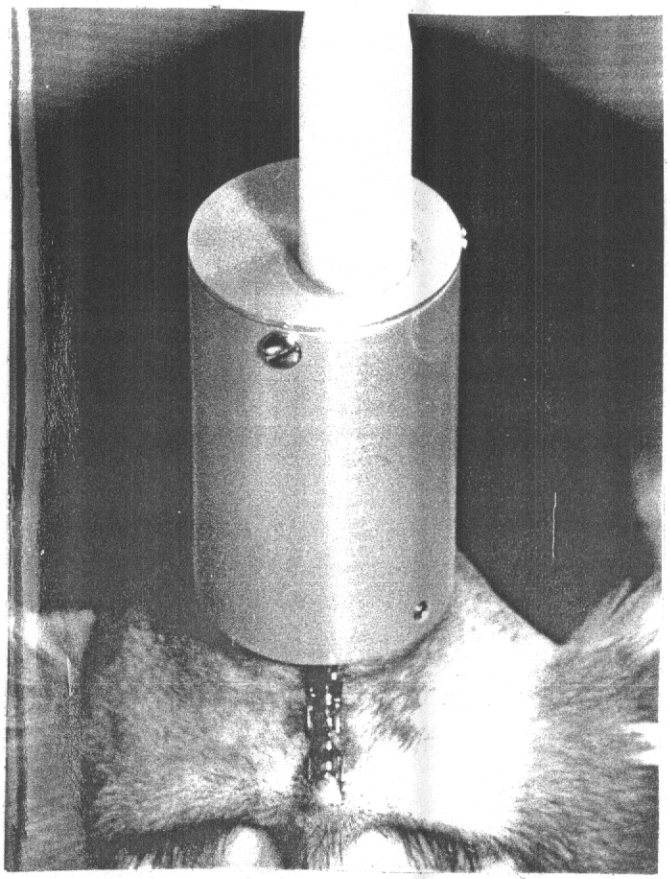


Figure 6. The transmitter container assembly attached to the animal.

REFERENCES

Anschel, S. A micro-miniature connector for intracranial electrodes. *Psychological Reports*, 1967, *20*, 1321-1322.

Delgado, J. M. R. Radio stimulation of the brain in primates and man. *Anesthesia and Analgesia: Current Researches*, 1969, *48*, 529-542.

MacKay, R. S. *Bio-medical telemetry: sensing and transmitting biological information from animals and man*. New York: John Wiley, 1968.

Ruch, T. C., & Spelman, F. Telemetry. In W. I. B. Beveridge (Ed.), *Primates in medicine*. Basel: S. Karger, 1969. Pp. 103-112.

Schwartz, A. S., Eidelberg, E., & Cheshire, F. A jacket for stimulating and recording from monkeys. *Electroencephalography and clinical neurophysiology*, 1967, *22*, 563-564.

Van Citters, R. L., & Franklin, D. Radio telemetry techniques for study of cardiovascular dynamics in ambulatory primates. *Annals of the New York Academy of Sciences*, 1969, *162*, 137-155.

TRACKING GIBBONS IN TROPICAL FOREST USING RADIO TELEMETRY[1]

Bruce A. Ross[2]

SEATO Medical Research Laboratory

Gershon Berkson[3]

Delta Regional Primate Research Center

Four techniques are generally used to locate a gibbon family group. (1) One can listen for the loud calls that most groups emit during the morning and then move toward the source of the sound until one comes upon the animals. Gibbons do not, however, call every morning, and their calling is often too short or too infrequent to permit location of the group. (2) One can go to the group's sleeping location before dawn, but this requires following the group the afternoon before without alarming it. (3) A group can sometimes be seen from a lookout above its home range, but such prospects are usually not available. (4) A last resort is to walk through the group's home range until the animals are incidentally encountered, but this method is quite time consuming.

None of these techniques is efficient if one wishes only to make a quick check of a group's location or to keep a few animals under intensive or very frequent observation, and all four methods often fail entirely. In an attempt to improve on them, a radio tracking method of demonstrated reliability (Slater, 1963; Tester, 1963) was applied to gibbons. To our knowledge, this is the first reported use of radio-tracking with forest primates. Watson, Franklin, and Van Citters (1968) have reported a backpack attachment of radios to free-ranging baboons, but their much larger device was used for telemetering physiological data rather than simple tracking.

Method

Radio-tracking was used with five adult white-handed gibbons,

---

[1]The study was supported in part by PHS Grant No. FR-00164 from the Division of Research Facilities and Resources. Dr. Vichit Lochirachunskun and Dr. J. R. Tester gave technical advice. The investigation adhered to the "Guide for Laboratory Animal Facilities and Care", of the Institute of Laboratory Animal Recources--National Academy of Sciences.

[2]Present address: Department of Conservation, School of Natural Resources, University of Michigan, Ann Arbor, Michigan 48105.

[3]Present address: Illinois State Pediatric Institute, 1640 W. Roosevelt Road, Chicago, Illinois 60608.

Hylobates lar, that were part of a behavior study (Berkson, Ross & Jatinandana, in press) which required quick location of the subjects at any time of day. Three gibbons were tame, two were feral, and all were captive before the project began.

There were two study sites. One male gibbon with a radio was released at Ko Klet Kaeo Island, a primate research facility in the Gulf of Thailand near Sattaheep, Thailand (Berkson, 1968). The island is about 23 hectares of steep terrain, densely wooded with second growth trees and bushes forming a canopy from 1 to 8 meters with some scattered taller trees. At the second site, an isolated patch of forest in Khao Yai Park, located 110 km northeast of Bangkok, Thailand, two heterosexual pairs with radios were released. The forest patch is about 3 hectares of mature evergreen forest; it is less densely wooded than the island, but the much higher canopy at 12 to 40 m provided ample cover for the gibbons to hide or flee unseen.

The transmitters were embedded in acrylic collars (Mech *et al.*, 1965), with battery systems estimated to last 12 months. Each of these transmitter-collars weighed 180 g, which the gibbons carried with no observed effects. The estimated power output was 0.25 mw and the four transmitters[4] used broadcast at 26.2, 26.4, 26.6 and 26.8 mc.

The receiver, a portable Davco Model DR-30, employed a directional loop antenna (Singer Co. Model LP-205), 12 inches in diameter and tuned to 12.7-30 mc. Using earphones, we determined the direction of the gibbon by noting the null effected in the signal when the antenna was turned perpendicular to the source. By a series of triangulations, we could generally move to within 10 m of the gibbon. If the animal was not visible, we could wait for it to give away its position by moving, or we could flush it.

Results

The system was tested for accuracy at Ko Klet Kaeo and in an open field, by keeping the receiver stationary and placing the transmitters at varying distances. The deviation in degrees between the actual and indicated locations averaged 3.4° (range 0-8°) at Ko Klet Kaeo and 4.8° (range (0-10°) in the open field. The error did not vary with distance within the maximum range of 100 m in the island vegetation and 200 m in the open field.

The signal was not observed to be affected by tall trees but was apparently affected by steep slopes. When the line between the transmitter and receiver was perpendicular to the fall of a slope, the signal would be deflected, making the transmitter appear to be upslope from its true position. This deflection varied from 0 to 15°.

---

[4]The transmitters were acquired from the Davidson Company, Minneapolis, Minnesota.

This degree of accuracy was acceptable for our purposes. If more accuracy were desired, it could have been attained with stationary antenna and more sensitive receiving equipment. Range could be increased by using more powerful transmitters.

We were able to locate the gibbon on the island within 30 minutes and usually only in the time it took to walk to his area. The animals in the mature forest site could be located within 15 minutes. Thus use of the radio made possible quick location of the animals, and in some cases allowed observations that would otherwise have been impossible. For example, one gibbon died in the mature forest site. The signal from the transmitter led us to the decayed and scattered remains, which would not have been found otherwise. The transmitter collar was retrieved and used on another gibbon.

The gibbons became accustomed to the transmitter-collars quickly and carried them without observed difficulty while brachiating in the forest canopy. One of the gibbons tried to pull his collar off at first, but his attempts were not vigorous, and after a few hours he lost interest. One animal wore a transmitter collar for four months without apparent ill effects. We did not recapture the others after their release, but no chafing or other problem was observed prior to their release, or with binoculars afterwards.

Conclusion

The study indicated that radio-tracking is a useful tool for locating forest-dwelling primates. We found both the 26 mc range and the acrylic collars appropriate to the tropical environment. The acrylic collar method of attaching the transmitters should be easily adaptable to most primate species.

REFERENCES

Berkson, G. Ko Klet Kaeo, a new island research facility for primates. *Laboratory Primate Newsletter*, 1968, *7* [1], 3.

Berkson, G., Ross, B. A., & Jatinandana, S. The social behavior of gibbons in relation to a conservation program. In L. A. Rosenblum (Ed.), *Primate behavior*. Vol. II. New York: Academic Press, in press.

Mech, L. D., Kuechle, V. B., Warner, D. W., & Tester, J. R. A collar for attaching radio transmitters to rabbits, hares and racoons. *Journal of Wildlife Management*, 1965, *29*, 898-902.

Slater, L. (Ed.), *Biotelemetry, the use of telemetry in animal behavior physiology in relation to ecological problems*. New York: Macmillan, 1963.

Tester, J. R. Radio tracking of ducks, deer and toads. Minneapolis Museum of Natural History Technical Report No. 6, 1963.

Watson, N. W., Franklin, D. L., & Van Citters, R. L. Backpack for free-ranging primates. *Journal of Applied Physiology*, 1968, *24*, 252-253.

* * *

MEETING REPORTS: INTERNATIONAL SYMPOSIUM ON COMPARATIVE GENETICS IN PRIMATES AND HUMAN HEREDITY

This symposium was held in Erice, Trapani, Sicily, July 23-29, 1970. It was sponsored by the National Research Council of Italy, the Regional Sicilian Government, the Italian Ministry of Public Education, and the Institute of Anthropology, of the University of Turin.

The program was as follows:

OPENING REMARKS: B. Chiarelli, Istituto di Antropologia, Università di Torino, Torino, Italy. INTRODUCTION: *Importance of the comparative method in genetics and particularly of comparative genetics in primates in order to study human heredity*, by H. Kalmus, Department of Human Genetics and Biometry, The Galton Laboratory, London, England. CYTOGENETICS: *Comparative cytogenetics in primates and its relation to human cytogenetics*, by B. Chiarelli, Istituto di Antropologia, Università di Torino, Torino, Italy. *Sex chromosome genetics in man and non-human primates*, by D. T. Hughes, Institute of Child Health, University of London, London, England. FORMAL GENETICS: *Blood groups of non-human primates and their relationship to the blood groups of man*, by A. S. Wiener and J. Moor-Jankowski, Department of Forensic Medicine, New York University Medical Center, New York. *The leucocyte groups in non-human primates; their relation to human leucocyte groups and to problems of hystocompatibility*, by H. Balner, Radiobiological Institute of Organization of Health Research T.N.O., Rijswijk, The Netherlands. *The P.T.C. (Phenil-Thio-Urea) test in primates*, by H. Kalmus, Department of Human Genetics and Biometry, The Galton Laboratory, London, England. *Variations and heredity traits in the serum protein of primates*, by M. Goodman, Department of Anatomy, Wayne State University, Detroit, Michigan, and M. L. Weiss, Department of Anthropology, Wayne State University, Detroit, Michigan. *Tissue and organ transplantation as an index of genetic affinity among primates*, by R. Cortesini, Istituto Trapianti d'Organo, Consiglio Nazionale delle Ricerche, Roma, Italy. BIOCHEMICAL GENETICS: *Biochemical characteristics of the serum proteins of non-human primates compared with those of man*, by M. Goodman, Department of Anatomy, Wayne State University, Detroit, Michigan, and A. Koen, Hawthorn-Plymouth Research Center, Northville, Michigan. *The comparison of the haemoglobins in non-human primates and their importance in the study of human haemoglobins*, by J. B. Sullivan, Department of Biochemistry, Duke University Medical Center, Durham, North Carolina. *The interest*

of a comparative genetic study of immunoglobin in man and non-human primates, by R. Cepellini and A. Carbonara, Istituto di Genetica Medica, Università di Torino, Torino, Italy. EPIGENETIC AND QUANTITATIVE TRAITS: *Epigenetic polymorphism (discontinuous traits) on the human and non-human primates skeleton*, by R. J. Berry and A. C. Berry, Royal Free Hospital School of Medicine, University of London, London, England. *Heriditary traits of human dentition present in non-human primates*, by D. R. Swindler, Department of Anthropology, University of Washington, Seattle, Washington. *The relevance of the dermatoglyphic traits for approaching quantitative heredity in non-human primates and man*, by J. Mavalwala, Department of Anthropology, University of Toronto, Toronto, Canada. CONCLUSION: *Remarks and prospectives for comparative genetics between non-human primates and man*, by N. A. Barnicot, Department of Anthropology, University College London, London, England

* * *

PILOT PROGRAM INITIATED FOR PRIMATE ZOONOSIS SURVEILLANCE*

In 1970, a pilot program for the surveillance of spontaneous disease in nonhuman primates was begun at the National Communicable Disease Center. The program, a joint effort of the Epidemiology and Foreign Quarantine programs, NCDC, and the Division of Research Resources, National Institutes of Health, is based on voluntary reporting of morbidity and mortality by participating centers. The purpose of the program is to determine the health hazard to humans who handle nonhuman primates and to develop effective control measures.

Six primate centers and the Animal Breeding and Holding Unit, Scientific Resources Branch, Laboratory Division, NCDC, are participating in the program. The centers include the Delta Regional Primate Research Center, Tulane University, Covington, La.; National Center for Primate Biology, University of California, Davis; New England Regional Primate Research Center, Harvard University, Southborough, Mass.; Washington Regional Primate Research Center, University of Washington, Seattle; Wisconsin Regional Primate Research Center, University of Wisconsin, Madison; and the Yerkes Regional Primate Research Center, Emory University, Atlanta, Ga.

For further information about the program, contact Dr. Arnold Kaufmann, Chief, Comparative Pathology Unit, Bacterial Diseases Branch, Epidemiology Program, National Communicable Disease Center, Atlanta, Ga. 30333.

---

*From *CDC Veterinary Public Health Notes*, June, 1970, prepared by The Veterinary Public Health Section of Epidemiology Program of the National Communicable Disease Center, Atlanta, Georgia.

MOUNTAIN GORILLAS IN RWANDA[1]

In a brief note in the September 1969 *Oryx*, page 91, Michael Woodford described an encounter with four mountain gorillas on Mt. Karisimba, in the Parc des Volcans in Rwanda. His account was purely concerned with observations made on this one visit to a part of the volcano, but a member of the Fauna Preservation Society in Rwanda, Mr. R. I. M. Campbell, writes to point out that it could mislead readers into thinking all was well with the mountain gorillas, apart from a few illegal cattle herds and local people climbing the volcanoes for bamboo; this is not the case. Mr. Campbell writes:

"In the Parc des Volcans and the adjoining Parc National Albert, the situation concerning the safety and continued survival of the mountain gorilla--let alone the other animals that still exist there--is extremely critical. In this final retreat the gorillas of the Virunga range of volcanoes are very hard pressed by human intruders and cattle herds. There is virtually no control in these parks. Poachers, cattle herders and honey-hunters roam where they will without restraint. The poachers hunt with bows and arrows, spears and dogs, and set hundreds of bamboo-sprung noose traps to catch the forest antelopes. These men do not hunt quietly and secretly; the dogs have bells fixed round their necks and can be heard for miles, the hunters shout and yell to one another, have no fear of being interrupted, and work the parks from end to end.

"Mr. Woodford says he did not see any evidence of cattle on Mt. Karisimbi. Maybe it was not his intention to convey that cattle are not to be found on Karisimbi, but I am sure readers will infer this. During the height of what might be called the dry season, the slopes of this particular mountain probably support the largest concentrations of cattle. Wherever there is suitable forage, there you will find cattle--throughout the saddle areas and up the sides of the volcanoes, as high as they care to go. Only the steepest slopes and ravines, where they have difficulty in maintaining a secure footing, are *relatively* safe. The cattle herders live in the mountains for months on end and build small shelters and bomas. They also have no worries about being disturbed.

"A large part of the volcanoes is covered with beautiful hagenia woodland; one seldom finds bamboo growing above the 9,000 foot mark. When the time is right, groups of men invade the parks in search of honey. Wherever possible they smoke the bees out--often leaving the fires smouldering with the result that the tree is burnt out. However, should the bee hive be out of reach they will not hesitate to hack the tree down. What with the bawling of the cattle, the shouts and calls from poachers and herders, the sound of axes and the sight of smoke,

---

[1]Reprinted from *Oryx*, 1970, *10*, 256-257. The editor's note at the end of the article is also from *Oryx*.

the casual observer could be excused for thinking that the volcanoes are freely inhabited--and not park area at all!

"If the Conservateur of the Parc des Volcans *would* shoot a few of the cattle, the deterrent effect would be great, but I have never heard of an incident where cattle have been killed. There is actually no need to shoot, for cattle can be herded with great ease. They can be impounded or confiscated with no difficulty at all. What could be easier than destroying trap lines? But they are left standing. Only the actual capture of men presents any real difficulty, but even they can be chased and disturbed, their shelters destroyed and life made difficult. Throughout the park, only one small area receives some measure of protection. Living at 10,000 ft.--under the southern slopes of Mt. Visoke, Miss Dian Fossey, a courageous American girl, who has been studying mountain gorillas for the past three years, does all within her power to keep the intruders at bay, and she puts the Conservateur and his guards to shame. Fearlessly routing herders and poachers alike, destroying hundreds of snares and scores of shelters, confiscating axes, spears, bows and arrows and anything else left by the men in their hurry to get away, she ensures that the gorillas in her study area are able to live in relative peace and security--but her range is small, and what of the gorilla groups that survive in other sections? In all probability the four animals seen by Mr. Woodford are some of the remnants of a group, or groups, hunted and scattered when park guards captured two youngsters for a Zoo in Germany (see *Oryx*, December 1969, page 143). The captures took place early in 1969, and who knows how many animals were hurt and killed when the operation was carried out?

"What of the future of mountain gorilla? Obviously, if present conditions continue and become worse, they have no long-term future. The old boundaries of the Parc des Volcans have long since been passed by settlement schemes, and further settlements are planned. Control over the area is so slight there may as well be none. The few gorilla groups that survive are increasingly confined to the final and steepest slopes of the volcanoes, and even there they are not free from disturbance. The slow process of extinction is well on its way."

Note: Another serious threat to the gorillas, we learn from another member recently returned from Rwanda, is the decision to excise 10,000 hectares from the national park in order to grow pyrethrum. Settlers have been brought in, roads built, and the wildlife in the area destroyed.--Editor.

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

BOOKS

International zoo yearbook. Vol. 10. Lucas, J. (Ed.) London: Zoological Society of London, 1970.

This year the book includes the following articles among others: The new small mammal house at London Zoo; New Asiatic primate grotto at Miami Monkey Jungle; Breeding common tupaias (*Tupaia glis*) at Tama Zoo, Tokyo; Birth and rearing of a brown lemur × red-bellied lemur hybrid (*Lemur fulvus* × *L. rubriventer*) and breeding of grey gentle lemur (*Hapalemur griseus*) at Asson Zoo; The breeding and maintenance of captive Goeldi's monkeys (*Callimico goeldii*); A cage labelling service; Notes on primates in the Asiatic primate grotto at Miami Monkey Jungle; A brief note on a modified formula for hand-rearing infant baboons (*Papio* sp.); Airborne transport of an uncaged, immobilised, 260 kg (572 lb) Lowland gorilla (*Gorilla g. gorilla*); Drug immobilisation of the carnivora. As in the past, the *Yearbook* also contains the annual record of all non-domestic species of vertebrates bred by zoos, aquaria, and primate research centers, and the annual census of rare species of vertebrates in captivity.

BOOKLETS, PAMPHLETS, CATALOGS

Nonhuman primate procurement: Standards and guidelines for procuring, compounding, holding, and transporting nonhuman primates. Washington, D. C.: National Academy of Sciences, 1970. (Available from Institute of Laboratory Animal Resources, National Academy of Sciences, 2101 Constitution Avenue, Washington, D. C. 20418)

This is a report of the Subcommittee for Procuring, Compounding, Holding, and Transporting Nonhuman Primates, Committee on Standards, Institute of Laboratory Animal Resources, National Research Council. The chairman of the subcommittee is Alan A. Creamer, Merck, Sharp & Dohme Research Laboratories. The publication is directed primarily toward primate dealers at the source and to airline personnel.

---

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

DISEASE

Pneumonia associated with *Bordetella bronchiseptica* in *Callicebus* species primates. Seibold, H. R., Perrin, E. A., Jr., & Garner, Anna C. (Tulane University, Delta Reg. Primate Res. Cen., Covington, La. 70433) *Laboratory Animal Care*, 1970, *20*, 456-461.

36 instances of bronchopneumonia associated with *Bordetella bronchiseptica* were found in necropsies of 139 *Callicebus* species primates (*Callicebus moloch*--129 *Callicebus torquatus*--10) during a 2-year period. The organism was the only bacterium isolated from 21 of the pneumonic lungs. A history of an upper respiratory infection was obtained in approximately 60% of the pneumonic primates. 90% of the animals died during the 6-week quarantine period. There was a direct correlation between the incidence of the disease and the number of animals acquired on a month-by-month basis. Clinical, microbiological, and pathological characteristics of the disease were described.

The isolation and identification of *Mycoplasma* from *Macaca mulatta*. Madden, D. L., Hildebrandt, R. J., Monif, G. R. G., London, W. T., Sever, J. L., & McCullough, N. B. (Sec. on Infectious Dis., Perinatal Res. Br., Nat. Inst. Neurol. Dis. & Stroke, Bethesda, Md. 20014) *Laboratory Animal Care*, 1970, *20*, 467-470.

This study reports the recovery of *Mycoplasma* from 55 conditioned pregnant rhesus monkeys (*Macaca mulatta*) and their offspring. Cultures of *Mycoplasma* (PPLO) were recovered from 105 of the 920 specimens obtained. The predominant species recovered, *Mycoplasma orale II*, *Mycoplasma salivarium*, and *Mycoplasma hominis I*, have previously been isolated from man.

The isolation and identification of *Mycoplasma* from *Cercopithecus aethiops*. Madden, D. L., Hildebrandt, R. J., Monif, G. R. G., London, W. T., McCullough, N. B., & Sever, J. L. (Sec. on Infectious Dis., Perinatal Res. Br., Nat. Inst. Neurol. Dis. & Stroke, Bethesda, Md. 20014) *Laboratory Animal Care*, 1970, *20*, 471-473.

Throat and genital tract swabs obtained from newly arrived grivet monkeys (*Cercopithecus aethiops*) were cultured for *Mycoplasma* (PPLO). From 30 of these monkeys, 41 isolates were obtained. The predominant serotype was *Mycoplasma orale II*. The navel strain, *Mycoplasma salivarium*, and *Mycoplasma laidlawii* were also isolated. Two serotypes different from any of the available serotypes were found. The fact that *Mycoplasma* were recovered from monkeys obtained within 3 weeks of capture suggests that these species were present in the "wild" population and were part of the normal *Mycoplasma* flora of these monkeys.

Cross infection with eighteen pathogens among caged laboratory animals. Kruse, R. H., & Wedum, A. G. (Industrial Hlth & Safety Directorate, Fort Detrick, Frederick, Md. 21701) *Laboratory Animal Care*, 1970, *20*, 541-560.

The extent of cross infection among caged laboratory monkeys, guinea pigs, mice, and chickens was examined with 18 pathogens. Experiments were designed to determine if cross infection would be eliminated by (1) ventilated cages, (2) various air-washing procedures, (3) elimination of excreta from cages, (4) ultraviolet irradiation, and/or (5) high efficiency air filters covering the cages. Animals exposed to an aerosol create a hazard to the experiment and experimenter because the usual post-exposure air-washing techniques do not remove microorganisms entrained on the fur. A forceful air-jet ruffling technique greatly reduced microorganisms from the fur. Ultraviolet irradiation or high efficiency air filters on the cages prevented infection of normal animals in adjacent cages. With most microorganisms, animals inoculated other than by aerosol challenge do not show cross infection.

Ovarian tumors in rhesus monkeys (*Macaca mulatta*). Report of three cases. Martin, C. B., Jr., Misenhimer, H. R., & Ramsey, Elizabeth M. (Dept. Obst. & Gyn., Sch. Med., U. Southern Calif., Los Angeles, Calif. 90033) *Laboratory Animal Care*, 1970, *20*, 686-692.

Ovarian tumors were encountered in 3 rhesus monkeys of the Carnegie colony during the 5-year period, 1964-1968. Approximately 75 animals were examined by laparotomy or autopsy during this time. Case No. 1: A large abdominal mass was palpated in a newly purchased adult female. Laparotomy disclosed a multilocular cystic tumor replacing the left ovary, which proved to be a papillary serous cystadenoma. Several areas of the tumor exhibited histologic characteristics of low grade malignancy. Case No. 2: A benign cystic teratoma (dermoid cyst) of the right ovary, 4 cm in diameter, was discovered incidentally at laparotomy in a pregnant animal. No ovarian enlargement had been detected at laparotomy 2 years previously. The animal had received x-irradiation in the interim, but the dose was well below that reported to produce neoplasia in monkeys. Case No. 3: Another incidental finding at laparotomy during pregnancy was a 1.5 cm ovarian tumor resembling a raspberry in appearance. Histologic examination revealed this to be a cavernous hemangioma, with a rim of ovarian tissue remaining along the hilar aspect of the tumor. The ovarian tumors previously reported in nonhuman primates (16 cases) have been tabulated.

Pulmonary acariasis (*Pneumonyssus simicola*) in colony-bred

Macaca mulatta. Knezevich, A. L., & McNulty, W. P., Jr. (Oregon Reg. Primate Res. Cen., 505 N.W. 185th Ave., Beaverton, Oregon 97005) *Laboratory Animal Care*, 1970, *20*, 693-696.

Four of 16 captive-born rhesus monkeys raised in the company of imported adults for up to 16 years were found at autopsy to be parasitized with lung mites. None of 96 surgically delivered fetuses or of 54 young animals raised alone or separately caged with the mother was infected.

Mediastinal and subcutaneous cervical granulomas produced by faulty esophageal intubation of kaolin mixture in macaques. Reed, R. E., Valerio, Marion G., Ulland, B. M., Valerio, D. A., & Stookey, J. L. (Dept. Animal Pathol., Coll. Agriculture, U. Arizona, Tucson, Arizona) *Laboratory Animal Care*, 1970, *20*, 720-725.

Sixteen macaques from 6 different laboratories developed subcutaneous cervical or mediastinal foreign body granulomas associated with an accidentally introduced kaolinite preparation. Lesions in cervical tissues were, with 1 exception, relatively benign, but in 2 of 6 monkeys with mediastinal involvement there was mild to marked respiratory distress. Elongated and irregularly outlined, highly birefringent crystals observed in all affected tissues were identified as kaolinite. Silica, dickite and carbonate apatite were also present in some tissues. The lesions were deduced to be the result of injury and penetration of the pharynx or cheek pouch by the rigid metal cannulae used to admister antidiarrheal suspensions containing kaolin.

Gingival hyperplasia in a *Macaca mulatta*. Ulland, B. M., Sibinovic, S., & Innes, J. R. M. (Bionetics Res. Labs., Inc., 5510 Nicholson Lane, Kensington, Md. 20795) *Laboratory Animal Care*, 1970, *20*, 756-758.

A case of gingival hyperplasia in a *Macaca mulatta* is described. The condition was characterized by gingival enlargement of considerable degree, being most pronounced on the labial surface of the anterior maxillary quadrants. The bulk of gingival enlargement was composed of relatively avascular fibrous tissue covered with hyperplastic to hyperkeratotic stratified squamous epithelium bearing long rete pegs. The etiology was unknown, but dilantin therapy was definitely excluded. The hyperplastic tissue was surgically removed and recurrence has not been observed to date.

Physaloptera tumefaciens in the stump-tailed macaque (*Macaca arctoides*). Windle, D. W., Reigel, D. H., & Heckman, M. G. (Neuroscience Lab., Res. Service, Veterans Administration, Wood, Wisconsin 53193) *Laboratory Animal Care*, 1970, *20*, 763-767.