

LABORATORY PRIMATE NEWSLETTER

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Edited by

Allan M. Schrier

with the assistance of

Fred Stollnitz

Consulting Editor: Morris L. Povar

Psychology Department
Brown University
Providence, Rhode Island

POLICY STATEMENT
(Revised January, 1964)

The primary purpose of the Newsletter is to provide information on maintenance and procurement of nonhuman primates for laboratory studies. A secondary purpose is dissemination of general information about the world of primate research. Examples of the kind of practical information that would be useful are as follows: new drugs; novel aspects of cage design; new products; evaluations of various products; references to or short summaries of articles of general interest; experiences in connection with the procurement of monkeys. The Newsletter will also publish offers to exchange monkeys (for example, older monkeys for young or infant monkeys) and requests for monkeys with special characteristics (for example, good breeders or pregnant females). If someone has a special problem, he might want to request help through the Newsletter.

As a rule, only research articles or summaries which have some practical implications or which provide general information likely to be of interest to investigators in a variety of areas of primate research will be accepted for inclusion in the Newsletter. Descriptions of current research projects will also be welcome. It should be kept in mind that the Newsletter is not a formal publication and it is not likely to be obtainable in libraries. Therefore, citation of Newsletter notes or articles in publications is not recommended.

Information for the Newsletter will be welcome from anyone in any research area who is using monkeys or apes. The Newsletter will appear quarterly and will continue so long as people are interested enough to contribute items of information. The mailing list is open to anyone expressing an interest. There is no subscription charge. However, only new issues and back issues for the current year will be mailed to new subscribers free of charge. Volume 1 of the Newsletter may be purchased for \$2.00 and Volume 2 for \$1.00. (Please make checks payable to Brown University.)

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

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EDITOR'S NOTES

There are now 716 persons and organizations on our mailing list. Of these, 32 are libraries, and 96 are located outside of the United States and Canada.

A number of primate laboratories continue to supplement a diet of commercial chow with vitamins, fruits and other foods. This is both time-consuming and expensive. For some time now, the monkeys in the Primate Behavior Laboratory here at Brown have been maintained strictly on commercial chow (one of the dated varieties containing stabilized vitamin C) with highly satisfactory results. Specifically, a group of 30 rhesus monkeys and three cynomolgus monkeys has received this diet for a little over two years. For reasons not related to diet, the group also received a vitamin "sandwich" once a week the first year, but has not since then. A group of 24 stump-tailed monkeys and 15 Philippine cynomolgus has been on this diet for 7 to 10 months. We have also had at least 20 squirrel monkeys on it for varying periods of time; at least 2 years in the case of four animals. We have had no losses of Old World monkeys nor signs of dietary deficiency during the periods in question. Although we have lost some squirrel monkeys, we have never found the diet to be a factor. Of fourteen mature female rhesus paired with males during the period in which no food supplements have been given, 12 gave birth to viable offspring. One fetus was stillborn and one was aborted. Four of the 12 viable infants were given to another laboratory shortly after birth. The remaining eight, five of which are now 1-1/2 years old, have been reared only on mother's milk or a substitute for it and, later, commercial chow. All of these laboratory-reared animals are in excellent condition.

A request for information about tuberculosis in squirrel monkeys appeared in the previous issue of the Newsletter. During one of the paper-reading sessions devoted to laboratory primates at the recent Animal Care Panel meeting, Morris Povar asked whether any of the 100 or so persons present had ever made or heard of a diagnosis of tuberculosis in a squirrel monkey. None had.

We must confess that, after all the discussion (see in this Newsletter: Editor's Notes, January, 1964; On the Identification and Naming of 'Cynomolgus' and Other Monkeys, April, 1964; and On the Identification of Monkeys, July, 1964), we are not able to bring ourselves to follow our own advice to call the rhesus monkey Macaca mulatta mulatta and the cynomolgus monkey M. mulatta fascicularis. It seems highly likely that the whole genus, Macaca, will have to be revised eventually. Rather than making name changes piecemeal with each new bit of information, it seems best to hold off until much more information has been gathered. For the time being, therefore, we will continue to call the rhesus M. mulatta and the cynomolgus, M. irus. For the latter, we will note also their common names and that there is some justification for changing irus to fascicularis. We shall include as much additional information as we can in order to aid future identification.

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BLOOD GROUPS AND SERUM SPECIFICITIES OF APES AND MONKEYS

J. Moor-Jankowski¹ and Alexander S. Wiener²

Division of Experimental Immunogenetics and Oncology, Yerkes Regional
Primate Research Center, Emory University, Atlanta, Georgia
and

Office of the Chief Medical Examiner of New York City; Department
of Forensic Medicine, New York University School of Medicine

Despite its evident interest, until recently little was known about the blood groups of nonhuman primates. The most recent review of the subject by David Franks ("The Blood Groups of Primates", Symp. Zool. Soc. Lond., 1963, 10, 221-250) refers to only 66 original papers, covering the period of 1911 to 1962, 13 of them by A. S. Wiener. In addition, several of the publications reported results on one animal only, or findings disproved by later work.

This lack of information was due mainly to the unavailability of apes and monkeys for research purposes, to the lack of methods for handling them, and also to the complicated serological testing techniques, in which specific antisera were prepared by agglutinating human red cells and then removing the antibody from the surface of these red cells by elution processes.

The advent of larger primate laboratories in this country, including the Regional Primate Research Centers, alleviated the first difficulty by making sufficient number of animals available for research purposes. This, in turn, led to the development of simpler testing methods by selective absorption which is possible only when enough test animals are available. Also, in the meantime, new methods for handling of nonhuman primates have been developed. Finally, the availability of animals allowed for immunization experiments, which, in turn, led to the discovery of new simian blood factors.

This paper is intended as a brief survey of results obtained during two years of collaborative investigation, the results of which are at this time still partially in process of publication.

Human-like Blood Group Antigens in Nonhuman Primates

In the first part of our investigation, blood grouping reagents prepared for testing human red cells were used for typing red cells of nonhuman primates. This approach is based on the implication that closely related species possess similar serological properties. In fact, it has been found that reagents prepared for blood grouping in man can be used

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for studies on apes and monkeys, and, conversely, reagents prepared with blood from rhesus monkeys led to the discovery by Landsteiner and Wiener of the Rh-Hr blood group system of man.

It should be mentioned here, however, that the possible existence in nonhuman primates of "naturally" occurring iso-agglutinins other than anti-A and anti-B has also been investigated. For this purpose cross-testing of red cells with sera within the same A-B-O group has been carried out to a limited extent so far in chimpanzees, orangutans, gibbons, baboons and rhesus monkeys, but no distinct reproducible reactions have been observed.

A-B-O groups and Lewis substance.--In general, the human blood grouping reagents cannot be used directly for testing red cells of non-human primates because of the presence of interfering nonspecific hetero-agglutinins. This difficulty was overcome in our studies by suitably designed absorption experiments; for example, human anti-A clumps indiscriminantly most of chimpanzee red cells independently of their blood group; however, absorption of this antiserum with chimpanzee group O red cells, removed the nonspecifically clumping antibodies, and the antiserum remaining after the absorption reacts selectively only with the red cells of A specificity.

In the tests for the presence of ABH and Lewis blood group substances in saliva, the interference of nonspecific hetero-agglutinins is excluded by the testing techniques.

Table 1 presents the results of our A-B-O blood grouping tests on red cells, and the tests for ABH and Lewis substances on saliva. As can be seen, the apes have blood groups closely resembling the human A-B-O groups. However, in chimpanzees only groups A and O are present, while in gibbons and orangutans only the groups A, B and AB, but not the group O have been observed. Gorilla red cells gave weak reactions with the antisera used, but inhibition tests on saliva, and tests on serum for the "naturally" occurring antibodies (reciprocal to the blood group of the animal, and therefore indicating it), showed the few gorillas tested to be group B.

Thus, as far as the A-B-O blood groups are concerned, among the apes, gorillas are the most different from man, and most similar to Old World monkeys, since the A-B-O groups of gorillas are more readily determined from their secretions than from their blood, as it will be shown below to be the case in monkeys.

All apes tested to date (about 200) secreted ABH substance in their saliva, except for a single orangutan. Thus, only the orangutans share the polymorphism of the secretor status as found in man.

In contrast, pronounced differences have been found among the species of apes in the secretion of Lewis substance in the saliva: all gibbons and most chimpanzees tested proved to be nonsecretors of Lewis

Table 1
Human-like Blood Groups in Apes and Monkeys

Species	Total	Blood Groups	Red Cell Antigens	Saliva	Subgroups of A	Lewis Substance in Saliva
HOMO SAPIENS		O,A,B,AB	Like man	Sec & nS A-B-H	A ₁ A ₂	Les and nL
PAN SATYRUS	130	O,A	Like man	Sec A-H	A _{1,2} A ₂	+ and Les
PONGO PYGMAEUS	26	A,B,AB	Like man	Sec & nS A-B-H	A ₁ A _{1,2}	Les
HYLOBATES LAR	13	A,B,AB	Like man	Sec A-B-H	A ₁	nL
GORILLA GORILLA	4	B-like	+ -	Sec B-H		+ -
GORILLA BERENGEI	3	A	?	Urine A		
PAPIO CYNOCEPHALUS	152	A,B,AB	-	Sec A-B-H		Les and nL
MACACA MULATTA	10	B	-	Sec B-H		
MACACA IRUS	13	O,A,B,AB	-	Sec A-B-H		
MACACA NEMESTRINA	9	O,B	-	Sec B-H		Les
CYNOPIITHECUS NIGER	10	O?,A,B	-	Sec A-B-H		Les
ERYTHROCEBUS PATAS	12	A	-	Sec A-H		Les and nL
CEBUS ALBIFRANS	4	"O",B	"B" like	Sec B-H		nL
SAIMIRI SCIUREA	4	"O",A	"B" like	Sec A-H		nL
MARMOSETS	31	A	"B" like	Sec A,H-like		nL

substance, while all orangutans tested secreted Lewis substance.

The red cells of Old World monkeys failed to clump in anti-A, anti-B and anti-H reagents; the red cells of New World monkeys were clumped by anti-B reagents, however, analytical studies showed their B-substance to be of different specificity than that in man.

All the monkeys tested were secretors of ABH substances, so that their A-B-O groups could be determined from tests on the saliva, and by the presence of reciprocal antibodies in their serum, as had been first pointed out by Wiener 20 years ago. With regard to the Lewis substance, this was found in saliva of the Old World monkeys only.

M-N factors.--Table 2 summarizes the findings on red cell types M and N. All chimpanzees tested to date have M-like factors on their red cells; about half of them have the factor called by us the N^V factor, and about half lack this factor. The factor N^V is one of the human N factors, namely, the factor determined by lectin (seed extract) obtained from the plant Vicia graminea. In gibbons, M-like blood factors were absent in most of the animals tested, while the N^V factor was almost regularly present. In orangutans, about half of the animals had M-like factors, and about half lacked this factor, but none had the N^V factor.

These findings on M-N system not only demonstrate characteristic differences among the species of apes, but also indicate that the genetic mechanism for that system in apes is different from that in man.

Studies on monkeys (not shown in Table 2), confirm the regular presence of M-like blood factors in Old World monkeys, while the N^V factor appears to be absent from their red cells. In New World monkeys, only certain species show M-like factors, and then only with a few selected antisera; the N^V factor has not been observed.

Rh-Hr factors.--In tests with Rh-Hr antisera (cf. Table 3), all chimpanzees give the same reaction, namely, their red cells have blood factors Rh_0 , and hr' , but lack rh' , rh'' , and hr'' ; this is indicated by designating chimpanzees as type $\bar{R}h_0^{Ch}$. In serological analysis of anti- Rh_0 sera, absorption with chimpanzee red cells removed the reactivity for chimpanzee red cells with only little apparent effect on the reactivity of the reagent for human Rh_0 -positive red cells. Thus, all six human anti- Rh_0 sera tested behaved as if they contained two kinds of Rh_0 antibodies, one reactive for chimpanzee as well as human red cells, and the other reactive for human red cells alone.

Gibbons, on the other hand, have red cells reacting only with anti- hr' sera; and are therefore designated type $\bar{r}h^{Gi}$. It was possible to fractionate the human anti- hr' sera into their anti-human- hr' and anti-gibbon components,

Table 2
The M and N Blood Factors in Apes

SPECIES	<u>M</u> -LIKE FACTORS		
	PRESENT	ABSENT	TOTALS
PAN SATYRUS	130	0	130
HYLOBATES LAR	1	8	9
HYLOBATES PILEATUS	1	0	1
PONGO PYGMAEUS	12	12	24
GORILLA GORILLA	1	0	1
SPECIES	<u>N^v</u> FACTOR (<u>Vicia graminea</u>)		
PAN SATYRUS	42	62	104
HYLOBATES LAR	9	0	9
HYLOBATES PILEATUS	0	1	1
PONGO PYGMAEUS	0	24	24
GORILLA GORILLA	1	0	1

Table 3
The Rh-Hr Factors of Apes and Monkeys

SPECIES	REACTIONS OF RED CELLS WITH HUMAN ANTISERA					DESIGNATION OF TYPE
	ANTI- <u>Rh_o</u>	ANTI- <u>rh'</u>	ANTI- <u>rh''</u>	ANTI- <u>hr'</u>	ANTI- <u>hr''</u>	
CHIMPANZEES	+	-	-	+	-	<u>Rh_o</u> Ch
GIBBONS	-	-	-	+	-	<u>rh</u> Gi
ORANGUTANS	weak	-	-	weak	-	<u>Rh_o</u> Or
GORILLAS	weak	-	-	weak	-	<u>Rh_o</u> Go
OLD AND NEW WORLD MONKEYS	-	-	-	-	-	-

similarly though to a lesser extent than in anti-Rh₀ fractionation with chimpanzee red cells. Red cells of orangutans tested react, like those of chimpanzees, only with anti-Rh₀ and anti-hr' sera; the relatively low titers indicate that the blood factors must be quite different from the corresponding factors of chimpanzee and man. Red cells of gorillas tested had also both Rh₀ and hr' factors, with titers intermediate between those of chimpanzees and orangutans.

Therefore, according to the degree of resemblance of the Rh-Hr reactions to those of man, chimpanzee is closest to man, followed by gibbon, gorilla and orangutan in that order.

Red cells from Old and New World monkeys, including the rhesus monkey (Macaca mulatta), do not react with any human Rh-Hr antisera, even though the very first antisera of Rh specificity were produced by immunizing rabbits and guinea pigs with rhesus monkey red cells: this situation is an example of what is known as non-reciprocal reaction.

Other human-like blood factors.--The blood factor I behaves like a heterophile antigen, i.e. its distribution cuts across phylogenetic lines of primates, and also of other species. For example, in primates, it is present in man and in Cebus monkeys, but is absent or very poorly developed in anthropoid apes (cf. Table 4).

Only a limited number of experiments have been done with reagents of specificities such as anti-Kell, anti-Duffy etc. In view of the difficulty in distinguishing the group-specific reactions of such reagents from those due to the non-specific hetero-agglutinins also contained in these reagents, especially with sera requiring the anti-globulin technique, the results obtained have been difficult to interpret.

A short series of tests with anti-P reagents indicate that chimpanzees are P-negative.

Simian Type Blood Group Antigens

Most recent investigations have been carried out by antisera prepared against red cells of apes and monkeys. The following antisera are being prepared and are under study at the present time:

- (1) iso-immune antisera produced in various ape and monkey species,
- (2) antisera produced by cross-immunization between primate species, including the use of human red cells for immunization of other primate species,
- (3) hetero-immune antisera produced in rabbits immunized with red cells of primate animals.

Blood types recognized by antisera prepared by immunization with simian red cells are being referred to, by us, as "simian type" blood factors. These are to be distinguished from the human type blood factors determined by antisera produced against human red cells, which are also present in other primates, as described in the preceding chapters.

Table 4
Blood Factor I on Red Cells of Primates

SPECIES	TITER AT ROOM TEMPERATURE	
	UNMODIFIED RBC	FICINATED RBC
HUMAN ADULT	32	640
HUMAN CORD BLOOD	0	20
HYLOBATES LAR	0	0
PAN SATYRUS	0	0
PONGO PYGMAEUS	0	4
GORILLA GORILLA	0	4
CEBUS ALBIFRANS	128	1,000
HUMAN ADULT	4	56
HUMAN CORD BLOOD	0	2
PAPIO CYNOCEPHALUS	0	1
OEDIPOMIDAS OEDIPUS	24	32
SHEEP	0	0
RABBIT	214	256

In our immunization program, significant results have been obtained so far by iso-immunization of chimpanzees and gibbons, and by cross-immunization of chimpanzees with human red cells.

Chimpanzee antisera produced against chimpanzee red cells recognize, to date, three different simian blood factors designated A^c, B^c and C^c, - the superscript "c" indicating the chimpanzee origin of the antigen used for immunization. Tests on 75 chimpanzees from the Yerkes and Delta Regional Primate Research Centers, demonstrated that blood factors A^c and B^c together with blood factor N^v, belong to one and the same new blood group system, designated the V-A-B simian blood group system. This system comprises eight blood types resulting from different combinations of the factors A^c, B^c and N^v; it behaves serologically similarly to the M-N-S antigens and antibodies in man: for example, ficinated red cells fail to react. Heredity of the V-A-B blood group system is by multiple allelic genes, a simple nomenclature has been devised, and family studies are being carried out on the Yerkes chimpanzee families.

Working independently, Zmijewski and Metzgar (Transfusion, in press) have produced another iso-specific chimpanzee antiserum by immunization with human red cells. A blood factor demonstrable by this antiserum and referred to by us as D^c has been shown to be related to the V-A-B simian blood group system of chimpanzees.

The simian blood factor C^c belongs to a blood group system which seems independent of the V-A-B system. The anti-C^c serum reacts not only by the antiglobulin method, but also on ficinated red cells. Using this reagent alone, we have been able to determine three types of chimpanzee red cells, namely C₁, C₂, and c.

Results of a population test for the distribution of the new simian type antigens among 60 Yerkes chimpanzees are shown in Table 5.

Table 5

DISTRIBUTION OF THE BLOOD FACTOR \underline{N}^V , AND THE SIMIAN BLOOD FACTORS \underline{A}^C ,
 \underline{B}^C AND \underline{C}^C AMONG 60 CHIMPANZEES

SERIAL NUMBER	BLOOD FACTORS				NUMBER OF CHIMPANZEES		BINARY NUMBER *
	\underline{N}^V	\underline{A}^C	\underline{B}^C	\underline{C}^C	GROUP A	GROUP O	
1.	-	-	-	-	0	0	0000
2.	-	-	-	+	1	0	0001
3.	-	-	+	-	1	0	0010
4.	-	-	+	+	5	1	0011
5.	-	+	-	-	8	0	0100
6.	-	+	-	+	4	0	0101
7.	-	+	+	-	6	0	0110
8.	-	+	+	+	3	0	0111
9.	+	-	-	-	2	0	1000
10.	+	-	-	+	1	1	1001
11.	+	-	+	-	12	0	1010
12.	+	-	+	+	7	0	1011
13.	+	+	-	-	5	1	1100
14.	+	+	-	+	0	0	1101
15.	+	+	+	-	1	0	1110
16.	+	+	+	+	1	0	1111

*This arrangement according to the binary system may prove useful also for purposes of coding.

Iso-immune antisera have been produced also in gibbons maintained at the Delta Regional Primate Research Center of Tulane University, and are now under investigation.

Chimpanzees cross-immunized with an individual human blood produced antibodies of a specificity partially parallel to that of anti-N^V, not found in serum of other chimpanzees immunized with different human bloods. This finding is being investigated, and indicates the correlation between ape and human blood iso-antigens, as proven also to exist in serum proteins.

Serum Specificities

Following the earlier work on blood groups, analogous crossreacting iso-antigenic systems have been revealed by more recent studies carried out since 1959 in sera of nonhuman primates and in man, the general concept and the results obtained so far are presented schematically in Table 6.

By the gamma globulin inhibition tests, using anti-human globulin rabbit antisera, the sera gamma globulins in ape and monkey blood have been compared with that present in man (cf. Table 7). Here again, the results support the conclusion that among the anthropoid apes, chimpanzees are most closely related to man.

Some Applications of the Present Findings

Studies of the human-like and simian type blood group antigens have been carried out in the recent cases of chimpanzee-to-man, and baboon-to-man kidney heterotransplantations, and rhesus monkey kidney homotransplantations. They have borne out, among others, the importance of blood group antigens of both human-like and simian type for experimental studies of transplantation reactions.

The amount of information accumulated during the last two years now allows attempts of the first comparative study of geographical and species distribution of blood groups in nonhuman primates, similar to studies on blood group distribution in man.

Furthermore, the accumulated data are being now investigated to provide additional information about the taxonomical relationship of ape and monkey species.

In addition to the above work, studies of platelets and white cell antigens are being carried out in collaboration with Dr. N. R. Shulman, National Institute of Arthritis and Metabolic Diseases. Preliminary results already available indicate the possibility of further expansion of these studies which would provide additional information similar in scope to that already obtained on the blood groups of red cells.

Table 6

SERUM ANTIGEN SYSTEMS IN CLOSELY RELATED SPECIES



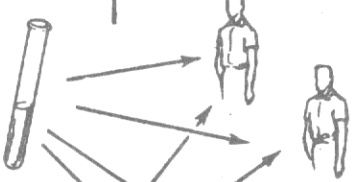






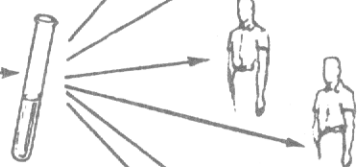

DESIGNATION OF THE SELECTIVE ANTIBODIES	SPECIES OF INDIVIDUAL ANTIGEN DONOR	SPECIES OF INDIVIDUAL PRODUCER OF IMMUNE ANTIBODIES	SPECIES POSSESSING POLYMORPHIC TRAITS RECOGNIZED BY THE IMMUNE ANTIBODIES
ISO-IMMUNE ISOSPECIFIC ISO-ANTIBODIES (IiI)			
ISO-IMMUNE HETEROSPECIFIC HETERO-ANTIBODIES (IhH)			
HETERO-IMMUNE HETEROSPECIFIC ISO-ANTIBODIES (HhI)			
HETERO-IMMUNE ISOSPECIFIC HETERO-ANTIBODIES (HiH)			
HETERO-IMMUNE HETEROSPECIFIC HETERO-ANTIBODIES (HhH)			

Table 7

REACTIONS OF PRIMATE SERA IN THE INHIBITION TEST
WITH ANTI-HUMAN GLOBULIN SERUM

The strength of the reactions is indicated by the number of plus signs, +++ being the strongest reaction possible and tr, $\frac{+}{-}$, and + indicating weak reactions. A minus sign indicates no reaction.

SPECIES	REACTION OF Rh ₀ -POSITIVE RED CELLS SENSITIZED WITH ANTI-Rh ₀ UNIVALENT ANTIBODY WITH ANTI-HUMAN GLOBULIN SERUM AFTER MIXTURE WITH PRIMATE SERUM									
	1:5	1:10	1:20	1:40	1:80	1:160	1:320	1:640	1:1280	1:2560
HOMO SAPIENS	-	-	-	-	-	-	-	-	tr	$\frac{+}{-}$
PAN SATYRUS	-	-	-	-	-	-	-	tr	$\frac{+}{-}$	$\frac{+}{-}$
GORILLA GORILLA	-	-	-	tr	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	++	++	++
PONGO PYGMAEUS	+	+	+	$\frac{+}{-}$	$\frac{+}{-}$	++	++	++	++	++
HYLOBATES LAR	$\frac{+}{-}$	$\frac{+}{-}$	++	++	++	++	++	++	++	++
PAPIO CYNOCEPHALUS	++	++	++	++	++	++	++	++	$\frac{+}{-}$	$\frac{+}{-}$
CYNOPIITHECUS NIGER	$\frac{+}{-}$	++	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$
MACACA MULATTA	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$
MACACA NEMESTRINA	++	++	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$
CEBUS ALBIFRANS	++	++	++	++	++	++	++	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$
NORMAL RABBIT	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
NORMAL HORSE	++	++	++	++	++	++	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$	$\frac{+}{-}$

Acknowledgments

Participation of Mrs. Eve B. Gordon in all the laboratory tests which led to the establishment of the presently available information is gratefully acknowledged. Drs. C. M. Zmijewski and R. S. Metzgar kindly provided us with their chimpanzee anti-human serum. The authors are greatly indebted to Dr. Arthur Riopelle, Director, Delta Regional Primate Research Center, Tulane University, New Orleans, La., who arranged for immunizations of a group of chimpanzees and gibbons. Mr. Charles Guthrie, at the Division of Experimental Immunogenetics and Oncology, Yerkes Regional Primate Research Center, and Misses Dina Santana, Pat Ryan and Sybil Gordon, at the Office of the Chief Medical Examiner, N.Y.C., assisted in the performance of actual tests.

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BREEDING SAIMIRI SCIUREUS

Edmore Hafner and L. S. Woodburne

Psychology Department, University of Washington

Those interested in the possibility of breeding squirrel monkeys may obtain some useful guidelines from the experiences of the Psychology Department at the University of Washington. Nothing could be found in the available literature about the breeding of squirrel monkeys, although a research project on this subject is reported to be under way at the Primate Research Colony of the San Diego Zoo at the present time (Lab. primate Newsltr, 1963, 2 [No. 2], 4). The present information is based on a group of 20 animals, composed of 19 females and one male. The animals were housed during quarantine in a large wire covered room with space to jump and climb. After one month quarantine, eleven of the females were found to be pregnant. Subsequently, a twelfth one was added to this group. The first parturition occurred during the month of June, 115 days after the animals were received from quarantine.

It was difficult to specify the menstrual cycle exactly. "Estrous", as indicated by swelling and reddening of the external genitals and a slight mucous exudate, was not observed in any animal less frequently than 21 days. Probably 28 days is average, as is true of the rhesus and other primates.

The chances of live birth, acceptance, and nursing by the mother were improved by housing the pregnant animals in complete privacy, screened both from other monkeys and from humans. There seemed to be a tendency for the pregnant squirrel monkey to withdraw from the group, particularly during late pregnancy. The cages for pregnant animals were covered on the sides exposed to noise and activity with black cloth, leaving a small corner for the females to look out. After several females delivered prematurely, even cage cleaning was avoided during late pregnancy. On two occasions two pregnant females were left together. In one instance, the one who delivered first also tried to claim the second baby. In the other, the female who had not yet delivered became so attached to the cage mate's baby that she ignored her own when it arrived. This may explain several of the rejections.

Reports by competent observers indicate that even under natural conditions there is a high mortality, possibly 25-30%. Out of the 12 pregnant females, four healthy babies survived that look like they will grow to maturity. Of the eight that did not survive, three were born prematurely. Two others, although carried to full term, were either rejected by the mother, or the mother was unable to nurse them. One of these mothers did not seem to know what to do with her baby. She picked it up but did not lift it up to nurse. Holding the mother and trying to aid the baby to nurse was not successful. When bottle fed, the baby began to gain some strength, for its grip was stronger, but it did not survive. The remaining three died after a few days, possibly from being

knocked against the bars when the mother swung around in the small cage. Since the babies cling mostly on the mother's back except when nursing, they are easily hurt when the mothers are excited as when attempts are made to catch them.

The male of the group is bigger and heavier and probably older than any other males previously received in this laboratory. He weighed in excess of 800 g and appeared to be 3-4 years old. Since the breeding age for male rhesus is 6 years it may be important to have an older male for successful breeding of squirrel monkeys.

As one result of this experience in breeding squirrel monkeys, a large "walk-in" cage resembling the quarantine unit (5' 10" high, 4' wide, and 8' long) was built. It was made of scrap 2" x 2" lumber and covered on the inside with hardware cloth. The sides, top, and ends were built separately and then bolted together after being painted. The floor of 3/4" plywood was covered with sawdust. Two small trees or branchings were toe-nailed to the floor and stapled to the frame and wire to provide perches and climbing room. The monkeys are more active and appear more natural in this large cage. This type of cage may help prevent the stiffness that develops in some squirrel monkeys when kept in small cages for several years. The cage may be used as a gang cage when not used for breeding.

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SERUM SAMPLES NEEDED

We are currently interested in comparing serums of representative primates for antibodies to a number of agents causing infections in man. We are, therefore, in need of 1.0 to 10.0 ml of serum from various non-human primates. It would be appreciated if anyone capable of supplying this serum contact the undersigned.

S. S. Kalter
Dept. of Microbiology
Southwest Foundation for
Research & Education
P. O. Box 2296
San Antonio, Texas 78206

INFORMATION ABOUT MACACA NEMESTRINA SOUGHT

We are presently engaged in research utilizing the monkey, Macaca nemestrina. Since this animal has not been commonly employed in research, there is little available information in the literature concerning its various characteristics. In view of this situation, we are contacting agencies which might have access to such information.

Examples of the categories of information which we desire include parametric studies of body measurement and weight within different age brackets (of particular importance is the change in brain and cranial measurements with age), autonomic and endocrine functions, and electroencephalographic, neuroanatomical and neurophysiological data. We would appreciate receiving any information of this nature whether in the form of reprints of already published data or as material from unpublished sources. In the case of unpublished materials or data which may not be in a form convenient to send, an indication of its general nature might provide a basis for specific questions.

Eugene Campeau, Jr.
Space Biology Laboratory
Brain Research Institute
The Center for the Health Sciences
Los Angeles, California 90024

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OLDEST ZOO MONKEY DIES; WAS STERILE*

On May 24, 1964, "Irish," a male Hooded Capuchin, Cebus fatuellus paraguayensis, San Diego Zoo's primate patriarch, died. He was the longest-lived monkey ever in captivity. He was received at an estimated four years of age in 1927 and unfortunately, the day and month of his arrival was not entered on the specimen card. While he was in the San Diego Zoo he sired twenty-four offspring including a set of twins. The last was born on May 30, 1957. Shortly thereafter he was unable to remain the dominant male in the colony and was placed with a nonbreeding female until his death. The frozen carcass was flown to Dr. W. C. Osman Hill, Associate Director of the Yerkes Regional Primate Research Center at Emory University. Dr. Hill made sections of the testes and found there was "no evidence of potency."

* From the July and August, 1964, issues of the AAZPA Newsletter. The information was supplied by Clyde A. Hill.

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Disease

- Blood parasites of Southeast Asian primitive primates. Dunn, F. L. (Geo. Williams Hooper Found., San Francisco Med. Cen., U. of Calif.) J. Parasitol., 1964, 50, 214.
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Drugs

- Methoxyflurane anesthesia in primates. Brinkman, D. C., & Burch, G. R. (Vet. Clin. Res., Pitman-Moore, Indianapolis, Indiana) Allied Vet., 1964, 36, 39.
- This drug (Metofane: Pitman-Moore) was used to anesthetize 43 male squirrel monkeys and one mangabey.

Physiology and Behavior

- Auditory discrimination behavior of normal monkeys. Wegener, J. G. (Goshen Coll., Goshen, Indiana) J. aud. Res., 1964, 4, 81.
- Studies in the area are reviewed and new data are described.
- Factors influencing "normal" SGO-T levels in the rhesus monkey. Robinson, F. R., Gisler, D. B., Dixon, D. F., Jr. (Senior author's address: AFIT, A & M Coll. of Texas, College Station, Texas) Lab. anim. Care, 1964, 14, 275.
- "Serum glutamic-oxalacetic transaminase determinations were made on the sera of fifteen Macaca mulatta monkeys following various procedures. The SGO-T levels following the initial optimum handling conditions were the lowest, averaging 30, 32 and 38 units. The highest average (72 units) was recorded

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ADDITIONS TO MAILING LIST

William M. Adams
Vet. Science Extension
The Pennsylvania State
University
University Park, Pa.

Roger W. Baker
Medical Research Branch
U.S. Army Medical Research
& Development Command
Washington, D. C. 20315

E. S. Barclay
Biological Production
& Development
Merck Sharp & Dohme
West Point, Pa.

Efraim Benhar
Weizmann Institute
of Science
P. O. B. 26
Rehovoth, Israel

William R. Bilderback
414 Burnside Drive
San Antonio, Texas 78209

Ashley O. Brinson
Berg Institute
N.Y. Univer. Medical Cen.
550 First Avenue
New York 16, N. Y.

Alfred O. Broome
The Univer. of Texas
Dental Branch
P. O. Box 20068
Houston 25, Texas

Hugh Brown
Dept. of Pharmacology
Abbott Laboratories,
Scientific Divisions
North Chicago, Illinois

Ralph E. Buckley
Animal Res. Facilities
Dartmouth Medical School
Hanover, New Hampshire

Pierre Buser
Laboratoire de Neuro-
physiologie Comparée,
Faculté des Sciences
9 Quai Saint-Bernard
Paris V^e, France

Eugene Campeau, Jr.
Space Biology Laboratory
Brain Research Institute
The Center for the
Health Sciences
Los Angeles, Calif. 90024

Bobby L. Caraway
3434 Bob Billa
San Antonio, Texas 78223

Julia D. Chappell
696 Haverhill Street
Lawrence, Massachusetts

L. R. Christensen
Berg Institute
NYU Medical Center
550 1st Avenue
New York, N. Y.

Pierre A. Conti
Merck Sharp & Dohme
Research Labs.
West Point, Pa.

J. James Cunningham
Animal Colonies
Syntex Inst. for
Molecular Biology
3221 Porter Drive
Palo Alto, California

M. J. Dobbelaar
Faculteit der Geneskunde
Katholieke Universiteit
St. Annastraat 313
Nijmegen, The Netherlands

Charles E. Eastin
Box 2, Medical Center
University of Kentucky
Lexington, Kentucky

Albert Einheber
Dept. Germfree Research
Walter Reed Army Inst.
of Research
Washington, D. C. 20012

Phillip A. Farber
Institute of Physical Med.
and Rehabilitation
N. Y. Univer. Medical Cen.
400 East 34th Street
New York, N. Y. 10016

Karl L. Gabriel
Animal Quarters
Hospital of the Woman's
Med. College of Pa.
Henry Ave. & Abbottsford Rd.
Philadelphia 29, Pa.

N. Gengozian
Medical Division
Oak Ridge Institute of
Nuclear Studies
P. O. Box 117
Oak Ridge, Tenn. 37831

Nelly Golarz
Colonial Research Inst.
Freeport, Grand Bahama

Eutimio Gonzales-Luarca
Instituto Nacional de
Virologia dela S.S.A.
Prol. Carpio y Priv.
Diaz Miron
Mexico 17, D. F.

Richard Grindeland
Biochemical Endocrinology
Ames Research Center
Nat. Aeronautics & Space
Administration
Moffet Field, California

Laszlo Gyermek
Syntex Laboratories, Inc.
701 Welch Road
Palo Alto, California

Allen W. Hahn
Dept. Biomedical Eng.
Drexel Institute
of Technology
Philadelphia 4, Pa.

Robert L. Hickman
Dept. of Medical Zoology
Div. of Comm. Disease
& Immunology
Walter Reed Army Inst. Res.
Washington, D. C. 20012

Stanley B. Horst
General Medical Research
V. A. Hospital
Houston, Texas 77036

Joseph V. Jemski
Technical Evaluation Div.
U.S. Army Biological Labs.
Fort Detrick
Frederick, Maryland 21701

Albert M. Jonas
Div. of Animal Care
School of Medicine
Yale University
375 Congress Avenue
New Haven, Connecticut

Herbert Kaye
Psychology Dept.
Brown University
Providence, R. I. 02912

John G. Keller
Biological Res. Services
Scientific Assoc., Inc.
6200 South Lindbergh Blvd.
Saint Louis, Mo. 63123

Donald J. Kimeldorf
Physiology-Psychology Br.
US Naval Radiological
Defense Laboratory
San Francisco, Calif. 94135

Anne Kitsikis
3 avenue Garennière
Fresnes (Seine)
Paris, France

U. S. Grant Kuhn, III
Res. & Development Labs.
Venereal Disease Res. Lab.
Communicable Disease Cen.
Atlanta, Georgia 30333

R. E. Kuntz
Dept. of Microbiology
Southwest Foundation for
Research & Education
P. O. Box 2296
San Antonio, Texas 78206

John T. LaCroix
Box 4474
Brooks AFB, Texas 78235

Abe Levy
Animal Care Center
The University of Texas
Medical Branch
Galveston, Texas

Alvin F. Moreland
Animal Department
Univer. of Florida
Gainesville, Florida

John H. Morris
Dept. Veterinary Med.
US Army SEATO Med.
Research Laboratory
APO 146
San Francisco, Calif.

Peter Morrison
Lab. of Zoophysiology
Inst. of Arctic Biology
University of Alaska
College, Alaska 99735

James S. Myer
Department of Psychology
The Johns Hopkins Univer.
Baltimore, Maryland 21218

Albert E. New
US Nav. Sch. Avn. Med.
US Nav. Avn. Med. Cen.-54
Pensacola, Florida

T. W. Penfold
Vivarium
University of Washington
Seattle, Washington 98105

Adrian A. Perachio
Dept. of Psychology
University of Rochester
Rochester, N. Y. 14627

Lawrence R. Pinneo
Delta Regional Primate
Research Center
Tulane University
Covington, La. 70433

Biological Laboratories
Pitman-Moore
Zionsville, Indiana

W. G. Pohl
George Washington Univer.
Room 101
2128 H Street, N.W.
Washington, D. C.

William H. Pryor, Jr.
107 Claggett
Brooks AFB
Texas 78235

Mathew R. Purvis
Life Sciences Research
IIT Research Institute
10 West 35 Street
Chicago, Illinois 60616

Richard N. Rossan
National Center for
Primate Biology
Univer. of Calif., Davis
Davis, California 95616

Earl E. Roth De
Dept. of Vet. Science
Louisiana State Univer.
Baton Rouge, La. 70803

Winslow G. Sheldon
Dept. of Pathology
U.S. Army Med. Res. Lab.
Fort Knox, Kentucky 40121

S. Sigmund Stahl
Dept. Periodontia &
Oral Medicine
College of Dentistry, NYU
339 East 25th Street
New York 10, N.Y.

Daris R. Swindler
Dept. of Anatomy
College of Vet. Med.
Michigan State University
East Lansing, Mich.

Gale D. Taylor
5055 Bayhead
San Antonio, Texas 78220

B. J. Wagg
Unilever Research Lab.
Colworth House
Sharnbrook, Bedford
England

P. S. Watts
The Institute of Medical
& Veterinary Science
Box 14
Rundle St. Post Office
Adelaide, South Australia

Edward A. White
Vigo Plant
Chas. Pfizer & Co., Inc.
Terre Haute, Indiana

Alton J. Wilson
Animal Farm Branch
Pine Bluff Arsenal
Arsenal, Arkansas 71603

Chief, Dept. Lab. Animals
Div. Vet. Med., WRAIR
WRAMC, Bldg. 40
Washington, D. C. 20012

Dir., Div. Vet. Med., WRAIR
Bldg. 40, WRAMC
Washington, D. C. 20012

Steven H. Weisbroth
Berg Institute
New York University
Medical Center
550 First Avenue
New York 16, N. Y.

ADDRESS CHANGES

Kenneth V. Anderson
Dept. of Psychiatry
School of Medicine
Yale University
333 Cedar Street
New Haven, Connecticut

R. Andrew
Dept. Biology
Yale University
New Haven, Connecticut

Don E. Batten
Psychology Dept.
Idaho State University
Pocatello, Idaho 83201

R. Charles Boelkins
Wisconsin Regional
Primate Research Center
1223 Capitol Court
Madison, Wis. 53715

Henry A. Cross
Dept. of Psychology
Texas Tech. College
Lubbock, Texas

Donald E. Furry
Dept. of Anatomy
College of Medicine
Univer. of Cincinnati
Cincinnati, Ohio 45219

Phillip C. Green
Department of Psychology
McMicken Hall
Univer. of Cincinnati
Cincinnati, Ohio 45221

Joe R. Held
Lab. of Parasite
Chemotherapy
NIAID, Cytology Sec.
Chamblee, Georgia

Charles W. Hill
Delta Regional Primate
Research Center
Tulane University
Covington, Louisiana

Donald L. Hutchinson
Magee-Women's Hospital
Pittsburgh, Pa. 15213

Kenneth M. Michels
Department of Psychology
Florida Atlantic Univer.
Boca Raton, Florida 33432

Suzanne Ripley
Apt. 4
335 62nd Street
Oakland, Calif.

J. F. Wright
Yerkes Reg. Primate Res. Cen.
Emory University
Atlanta, Georgia 30322