# LABORATORY PRIMATE NEWSLETTER

Volume 6, Number 3

July, 1967

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## POLICY STATEMENT
(Revised January, 1967)

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.

It should be kept in mind that the Newsletter is not a formal publication and it is not obtainable in most libraries. Therefore citation of Newsletter notes or articles should be limited to special circumstances. This also means that inclusion of material in the Newsletter does not preclude its publication in a journal. As a rule, authors of longer articles will receive two extra copies of the issue in which the article appears; reprints will not be supplied under any circumstances.

The Newsletter appears quarterly, and the mailing list is open to anyone in the primate field expressing an interest. There is no charge for new issues and back issues for the current year. Back volumes will be furnished free of charge to any library operated by a nonprofit organization with the understanding that they will be kept in the library. Individuals may purchase Volumes 1, 2, and 3 for $4.00 per volume, and Volumes 4 and 5 for $2.00 per volume. (Please make checks payable to Brown University.)

Preparation of articles for the Newsletter.--Articles and notes should be submitted in duplicate and all copy should be double spaced. Articles in the reference section should be referred to in the text by author(s) and date of publication, as for example: Smith (1960) or (Smith & Jones, 1962). Names of journals should be spelled out completely in the reference 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 Fiedler [In H. Hofer, A. H. Schultz, & D. Starck (Eds.), Primatologia. Vol. 1. Basel, Switzerland: Karger, 1956. Pp. 1-266].

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### Acknowledgment

The Newsletter is supported in part by U. S. Public Health Service Grant MH-07136 from the National Institute of Mental Health.

CONTENTS

AUTOMATED MULTI-ANIMAL ENVIRONMENTS FOR PRIMATES[1]

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## Abstract

This paper describes two environments, each holding several baboons, in which automatic programming made possible 24-hour concurrent experimental sessions for all animals. The behavioral techniques developed to conduct experiments on individual animals and to permit social interactions among them are also described.

## Introduction

The purpose of this report is to describe both the behavioral and physical technology which underlie the operation of an experimental space in which continuous and concurrent experiments may be carried out with several monkeys. The experimental space is divided into two or more separate areas by a system of automatic doors, and the animals are generally free to move from one area to another, subject only to restrictions imposed by the nature of the experiments. The animals live continuously in these environments. The first chamber of this type was for chimpanzees (Ferster, 1964). It was used in experiments where it was necessary to maintain the animals for long periods of time, and where it was impractical to transfer the individual animals to separate areas whenever an experimental session was to be run. The basic plan of multi-animal environments was formed at this time, and included the following characteristics: (1) One large section of the cage is a "social" area and can be occupied by more than one animal at a time. (2) Several smaller compartments are used as "work" cubicles in which the animals perform in behavioral experiments programmed and recorded separately for each individual. (3) Electrically-controlled doors connect these areas of the cage and can be operated by the animals themselves. The techniques and general concepts have been extended to experiments with baboons. Although these techniques and concepts may be suitable for many species, the discussion in this paper will be limited to a detailed description of two experimental spaces for baboons.

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[1]This work was supported in part by the Armed Forces Radiobiology Research Institute (Contract No. DA 40-146-XZ-464) and in part by the National Aeronautics and Space Administration (Grant No. NsG 450/21-015-001).

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## Allotment of Space and Control of the Subject's Movement Through That Space

As in the earlier automated environments, each baboon environment has several work areas and a social area. The social area is shared by all of the animals and may be occupied by one or more of them at a given time. Controlled movement between the individual work areas and the social area is accomplished with a system of automatic doors and entrance and exit compartments.

Entrance and exit compartments.--The separation and identification of the various individual animals in the environment is accomplished by entrance and exit cubicles bordering both the social area and individual work areas. This arrangement prevents the animals from running in and out of the work cubicles at random, allows the identification of each animal (see the section on the combination lock, below), and permits routing or processing of the individual subjects within the entrance cubicle. The same cubicle can be used on the way out of the work chamber (see environment 2, below) or a separate exit cubicle can be provided (see environment 1, below). The design of the equipment makes it possible to arrange control circuits which give an automatic indication of each animal's location in the experimental space. Movement of an animal from one location to another can be used as a reinforcer or reward for performance in the work chambers and/or it can be conditional upon the location of another animal.

The design and operation of the doors.--On each side of each door is a handle, a solenoid-operated lock, a light, and a push button (Figure 1).

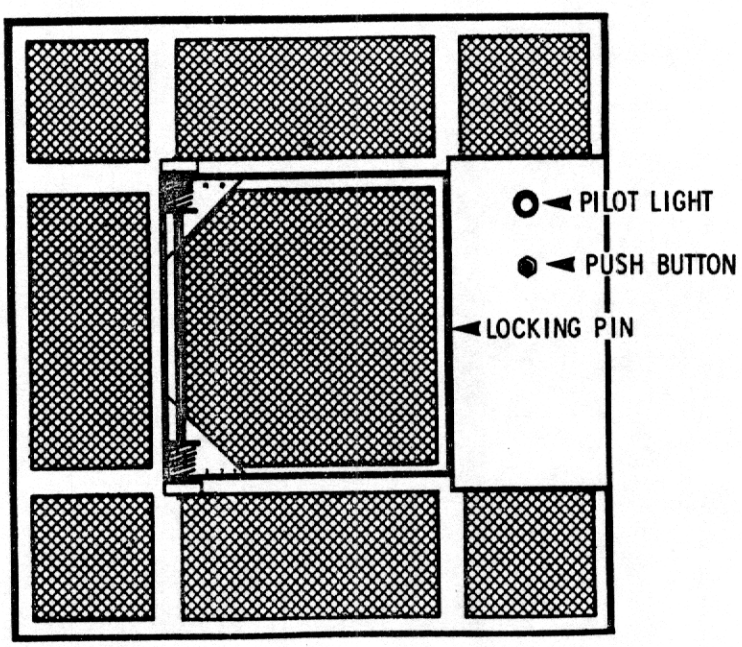



Figure 1. An illustration of the automatic doors used in the multi-animal environment.

The position of the door, open or closed, is monitored electrically by a striker plate and microswitch in one design, or by a system of magnets and reed switches in another. Only when the door is actually locked in place does the door switch record the door position as closed.

Figure 2 illustrates the operation of the door system between a

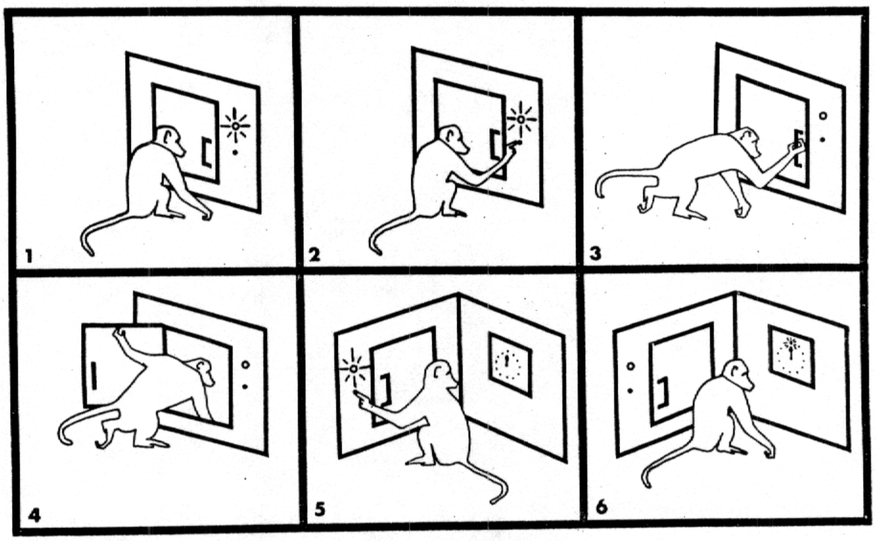



Figure 2. An example of the operation of the door in a multi-animal environment. Frames 1, 2, and 3: the baboon is outside of the entrance chamber. Frame 2: the animal is operating the push button. Frame 3: the animal is opening the door. Frame 4: the animal is entering the entrance chamber. Frames 5 and 6: the animal is inside.

social area and an entrance area, described later. An illuminated door light indicates that a door is "on". In such cases, if the animal pushes the door button (Figure 1, Frame 2), the locking pin is held in for approximately one second during which the door can be opened by means of the handle (Frame 3). If the animal does not open the door within the 1-second period, the door locks again and the button must be pushed again to open the door. When the door is unlocked or open or when it is "off", that is, is closed and cannot be unlocked, the lights are off, and responses on the push button have no consequences. The light on the inside of the door (Frame 5) comes on only when the door is closed. Pushing the inside button has consequences only when the animal is in the entrance cubicle with the door closed. By pushing this button, the baboon provides the signal that he is locked inside the chamber and, at the same time, turns the door off and turns on the lights on the combination lock which is described next.

<u>The combination lock</u>.--This device, used to identify animals at

critical points in the experimental space, consists of a circle of lights, a movable pointer, and a pilot light. Each animal in the environment is assigned a position on the combination lock, and is trained to hold the pointer at that position for 5 seconds. The pilot light on the face of the combination lock signals when the combination lock may be operated. As already mentioned, an animal may not operate the combination lock until the door behind him has been turned off. In another case, the pilot light on the combination lock would not come on if another animal is unaccounted for in the traffic control system. This prevents two animals from entering the same chamber. The physical arrangement and programming of the automatic doors and combination locks is called the traffic pattern. Particular traffic patterns are peculiar to the general design of the environment, and the kind of experiments which are being performed. However, in all cases the traffic pattern is an extended chain of behavior with specific discriminative stimuli providing the occasion for each member of the chain.

## An Environment in which the Exit and Entrance to the Work Chambers are Common to All Animals

Figures 3, 4, and 5 describe a cage environment (No. 1) used in several experiments, in which the exit and entrance to the work chambers are common to all animals. Each of six animals living in this cage had an individual work chamber. These chambers were arranged in two columns of three. The doors to the work cubicles opened onto a shaft which was used by all animals when they were entering or leaving the work chambers.

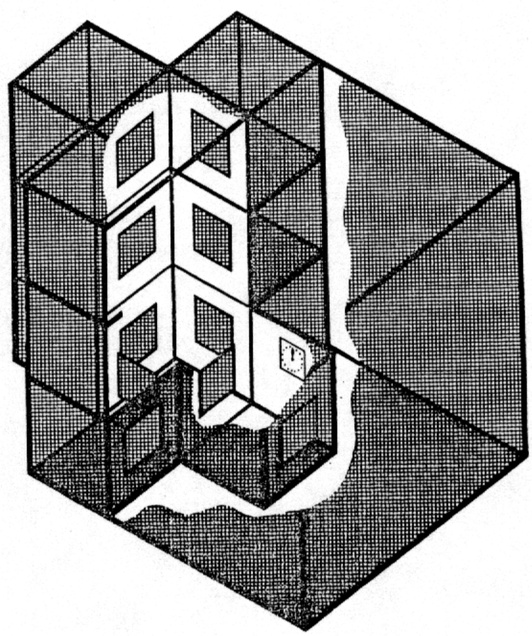


Figure 3. A perspective drawing of a multi-animal environment in which the entrance and exit chambers are common to all animals. The small squares illustrate the location of the doors, of which there are 10.

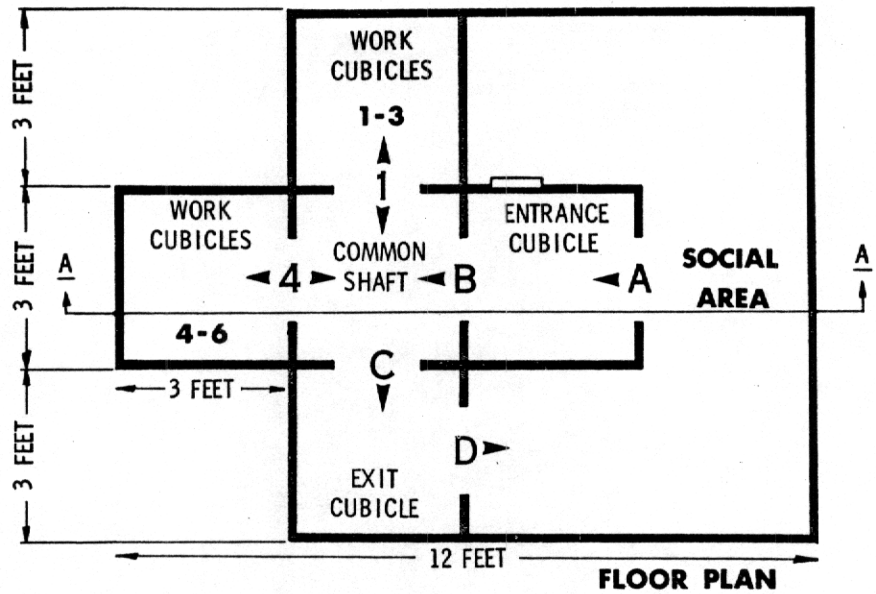



Figure 4. A floor plan of the multi-animal environment in Figure 3. Doors A, B, C, and D are the entrance and exit doors.

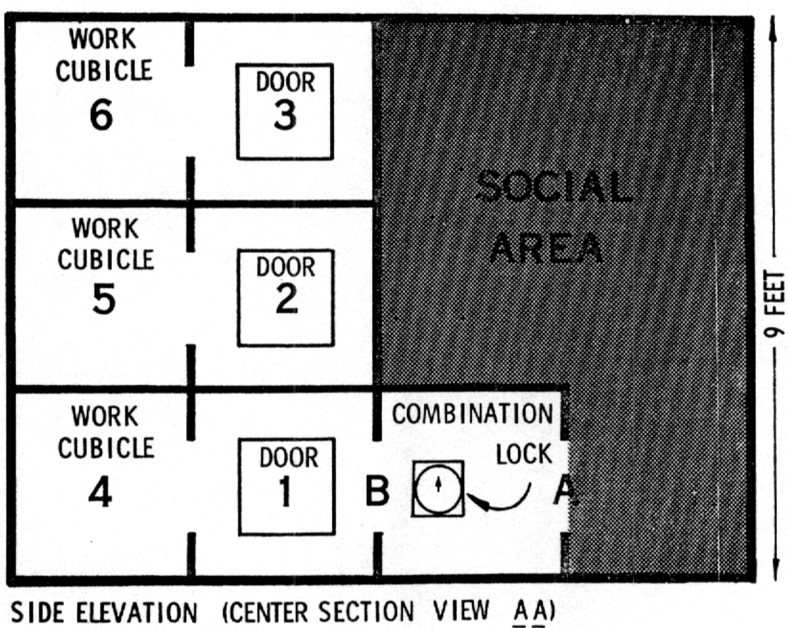



Figure 5. A side elevation of the multi-animal environment in Figure 3. Doors A and B and the doors to work cubicles 4-6 are represented by the breaks in the wall. The doors to work cubicles 1-3 are represented by open squares.

The cage was constructed of 3 by 3 ft. mesh panels interconnected by 1-1/4-in. steel tubing. The smallest cubicles in the cage, the work cubicles and the entrance cubicle, were 27 cu. ft. There were 10 automatic doors. Each was 15 by 15 in. and was hung on a 3 by 3 ft. mesh frame which also accommodated the associated equipment (Figure 1).

Figures 3, 4, and 5 show the locations of the 10 automatic doors in the cage. The combination lock was located in the entrance cubicle between doors A and B. The sequence of events involved in the movement of an animal from one location to another is essentially the same as described in Figure 2. This traffic pattern may be described as follows: (1) The baboon first unlocks door A (Figure 3) with a response on the push button; (2) after entering the entrance cubicle and closing the door, the next push button response on the inside of door A turns on the combination lock (door A goes off); (3) operation of the combination lock identifies the animal and turns on door B (4) which unlocks when the baboon presses the button. (5) A push button response on the inside of door B turns off that door and turns on the pre-set work cubicle door assigned to this animal. (6) The baboon enters the cubicle indicated by the pilot light and (7) the animal pushes the button on the inside of the door to his work cubicle which completes the entrance chain. This last response turns on the experimental program. The exit chain is similar except that the doors used are the door of the experimental chamber, and doors C and D.

_The control of the baboons' movements between the social area and the experimental chamber._--Since all animals used the same entrance and exit routes, specific kinds of automatic control over the movement of the traffic in and out of the work cubicles was necessary. Exit always had priority over entrance no matter which animal was in the chamber. If, however, an animal was inside the common verticle shaft on the way in, all of the doors from the other experimental chambers were turned off so that none of the animals in the work compartment could leave until this baboon was in his work cubicle.

Door A into the entrance cubicle was always on during the normal operation of the environment, unless the entrance cubicle was occupied. Food reinforcement was available at all times via the chain of responses required to get into the work cubicle and the schedules of reinforcement inside. The movement of the animals from the work cubicles to the social area was under the control of the individual animal's experimental program. After a specified number of food reinforcements (or some other condition such as elapsed time) the light on the door to the work cubicle was turned on and the animal was free to leave.

In order to make repairs, record data, or for some other reason keep a particular animal from entering his work cubicle, a "no work" condition was provided. On these occasions the individual animal was routed back out of doors C and D as soon as he responded on the inside push button of door B. Normally this response turned on his particular work cubicle door. This feature was included so that door A could be on at all times and particular animals could be kept out of their work cubicles. All the others were free to enter.

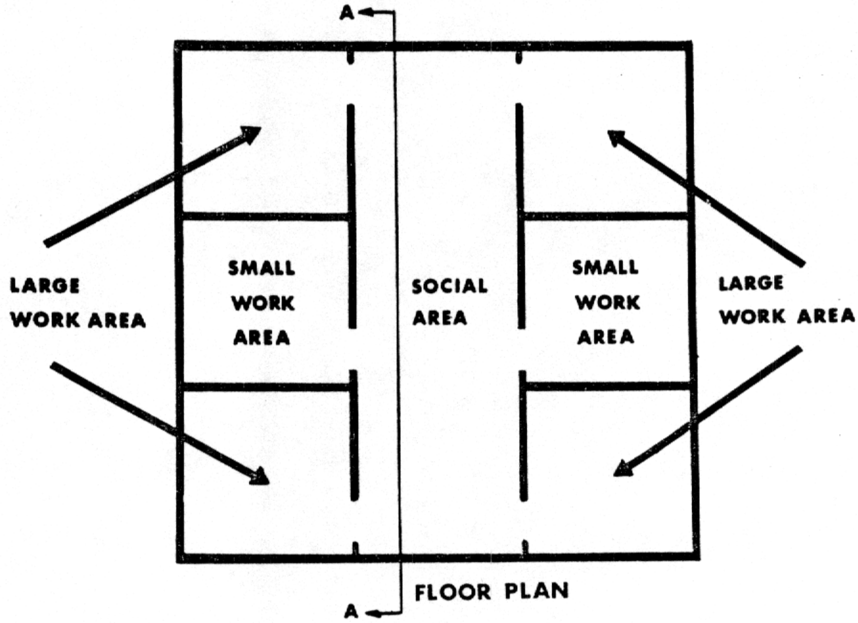
Each work cubicle contained a milled panel to which could be attached modules which contained the stimulus projectors, switches, and feeders used in the actual experiments. The panels in cubicles 1, 2, and 3 could be seen from the social area, and experiments could be carried out in which the behavior of an animal in the social area could be directly controlled by a discriminative stimulus in the cubicle.

Training procedures.--The behavioral components of the traffic pattern that required training were pushing buttons, operating the combination lock, and opening and closing the unlocked doors. Each animal spent approximately two weeks in a separate cage where standard shaping procedures (Skinner, 1953, ch. 4) with food reinforcement were used to develop the first two performances, pushing the button and operating the combination lock. Control of the push button response by the pilot light was also developed in the separate training cage by reinforcing the response in the presence of a pilot light and extinguishing it in its absence. The behavior of opening and closing doors was developed in the actual environment. See the following section for more details on the type of training procedures used.

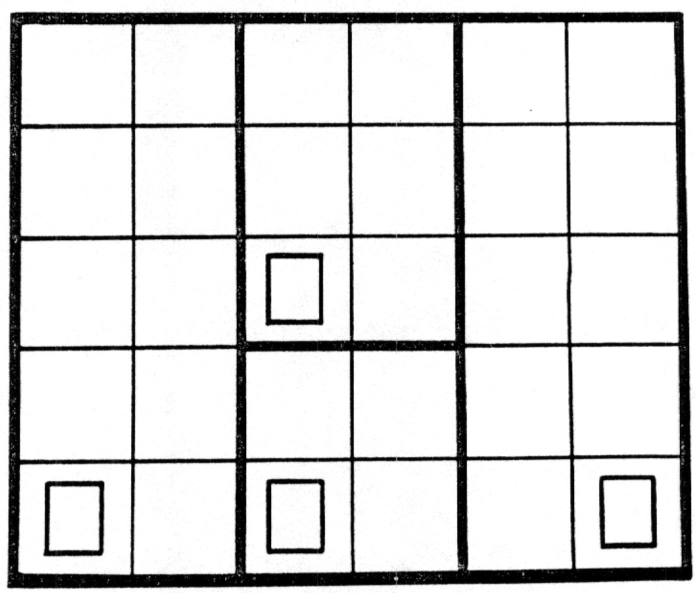
## An Environment with Entrance-Exit Chambers for Each Work Area

This cage environment (No. 2), designed to accomodate eight baboons, differs from the preceding one in that each animal's traffic pattern is independent of the other animals'. This is accomplished by having a separate entrance-exit area for each animal. The floor plan and an internal side-elevation are shown in Figure 6. The work areas, one for each animal, are located on opposite sides of a rectangular social area. The cage is approximately 12 by 12 by 10 ft. A large work area consisting of work and reinforcement compartments is located in each corner. Two small work areas are located between each of the larger ones. One of these, entered from the bottom of the social area is a 4-ft. cube, and the other is 4 by 4 by 6 ft.

Construction of the chamber.--Detailed sketches of the interior design of a large work area and a small work area are shown in Figures 7 and 8. The entrance area to the large work area (Figure 7) is a 2-ft. cube. One door faces the social area, the other provides access into the work area. The combination lock and an override switch (described below) are in the entrance area. A work panel is located immediately above a shelf in the upper portion of the large work area. The work panel contains, among other things, a series of visual display units and associated lever switches. The display units are used to produce visual discriminative stimuli for control of behavior with respect to each of these associated lever switches. In the lower left-hand corner of the work panel is a fourth lever switch and a jeweled pilot light. Responses on any of the switches have programmed consequences only when




FLOOR PLAN



SIDE ELEVATION AA

Figure 6. A floor plan (top) and internal side elevation (bottom) of a multi-animal environment in which each work cubicle has separate entrance and exit areas. The small rectangles in the internal side elevation represent the locations of the automatic doors.

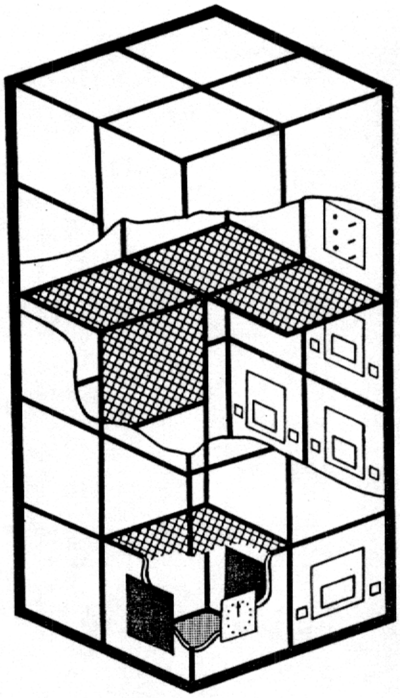


Figure 7. An illustration of one of the large work cubicles in the multi-animal environment in Figure 6. The two solid rectangles indicate the automatic doors. The work panel is at the upper right side. Four feeder panels are shown.

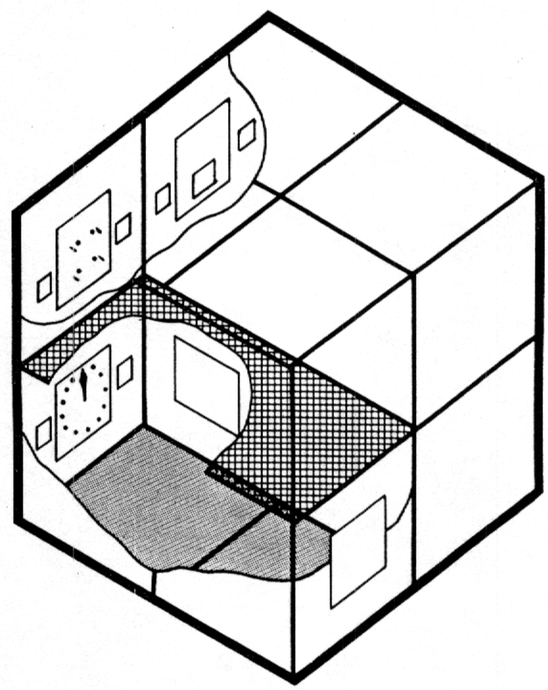


Figure 8. An illustration of one of the small work chambers in the multi-animal environment in Figure 6. A feeder panel, a work panel, a combination lock, and two automatic doors are shown.

the associated discriminative stimulus is illuminated. Separate reinforcement or feeder panels are located in the bottom portion of the large work area. Each feeder panel contains a 3-in.-square opening into a small stainless-steel box. Pellets fall into this box through a baffle system which prevents the animal from reaching the pellet dispenser located on the back of the panel. This panel also contains a lever switch mounted in the center of a 2-in. circle of plastic. This plastic may be illuminated from the rear. Associated with the light is a buzzer which may be operated in parallel with it. The light and/or buzzer serve as discriminative stimuli controlling approach to the feeder panel. As long as these stimuli are present, each response on the lever switch delivers one pellet of food. The entrance cubicle to the smaller work area (Figure 8) is 2 by 2 by 4 ft. One door faces the social area, the combination lock is located at the end of the cubicle on the outside wall, and the door providing access to the work area is on an inside wall. The work panel is placed over the entrance cubicle and the feeder panel is located on an adjacent side wall. A shelf, not shown in the drawing, extends under the feeder panel. The outside walls of all the work areas are opaque, providing minimal interaction with the exterior environment.

The environment is constructed with Unistrut[3] compartments, which are functionally similar to an erector set. It can be assembled, dismantled, or rearranged with a few simple tools. Individual panels may be easily removed. The superstructure is a frame into which 2-ft. panels may be inserted. Three types of panels are used: (a) blank metal panels, (b) specially designed aluminum panels which hold work panels, etc., and (c) wire mesh screen sections. With this overall modular construction system, any aspect of the physical environment can be fairly easily rearranged.

The automatic doors are constructed from flat metal sections, and are opaque. A system of magnets and reed switches is used in place of the striker plate and microswitch system of environment 1 to determine whether the door is open or closed. This permits a tight seal around the electromechanical system for control of the door.

The combination lock also involves a system of magnets and reed switches to provide feedback from the animal's operation of the pointer. The reed system provides for smooth operation, protects the electrical components of the system from dust and atmospheric changes, and works reliably for extended periods of time without maintenance.

<u>Traffic control system</u>.--While the system for guaranteeing the locus of a given animal in any portion of environment 2 and maintain-

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[3]This material is manufactured by the Unistrut Corporation, 4118 South Wayne Ave., Wayne, Michigan.

ing the integrity of the work cubicle is equivalent to that used in the first cage, the separate entrance and exit cubicles for each work area provide the opportunity for a more flexible traffic control system. In particular a switch, the override switch, has been added which may be operated concurrently with the combination lock. Operation of this switch turns on the inside of the door to the social area and allows the animal to exit from the entrance cubicle rather than entering the work cubicle. Therefore, an animal can escape from an aversive social situation by entering his entrance cubicle and turning off the door behind him. He is not committed at this point to enter the work cubicle, and may return to the social area by operating the override switch. This contingency was added to eliminate exposures to the experimental conditions which might occur as a function of aversive aspects of the social situation.

Figure 9 is a schematic diagram of the entrance sequence. To enter his work cubicle from the social area the subject must first operate door A, the door separating the entrance cubicle from the social area. A response on the inside push button of door A, when it is closed, turns door A off. (The side closest to the social area of any door is referred to as the outside of that door, and the side closest to the work area is referred to as the inside of that door.) The discriminative stimuli controlling the combination lock performance and the override option are turned on by this response. A response on the override switch turns the combination lock off, and turns on the inside of door A. The first response on the inside push button unlocks door A for 1 second. Following this period, or when the door is closed, if the animal has opened it, the lights on both sides of the doors are illuminated. A response on the outside push button unlocks the door again, and a response on the inside push button turns the door off and the combination lock and override option on again.

There are two possible consequences contingent upon the operation of the combination lock. Door B, the door separating the work cubicle and the entrance chamber, is turned on and the combination lock and override option are turned off, if the position appropriate to that work area is chosen, i.e., the correct animal has operated the combination lock. The combination lock and override option are turned off, and the inside of door A is turned on by the selection of an incorrect position of the combination lock, i.e., if another animal has operated the combination lock. In this case, the door sequence is identical to the one set up by the operation of the override switch.

Correct operation of the combination lock turns door B on. Responses on the inside of this door turn door B off, and the program and the inside of door A on. Following this, each response on the inside of door A will unlock the door for 1 second. The operation of door A in this mode makes no changes in the status of the traffic program. This condition was provided to permit the escape of an animal who might have entered the entrance chamber with the correct animal, but did not

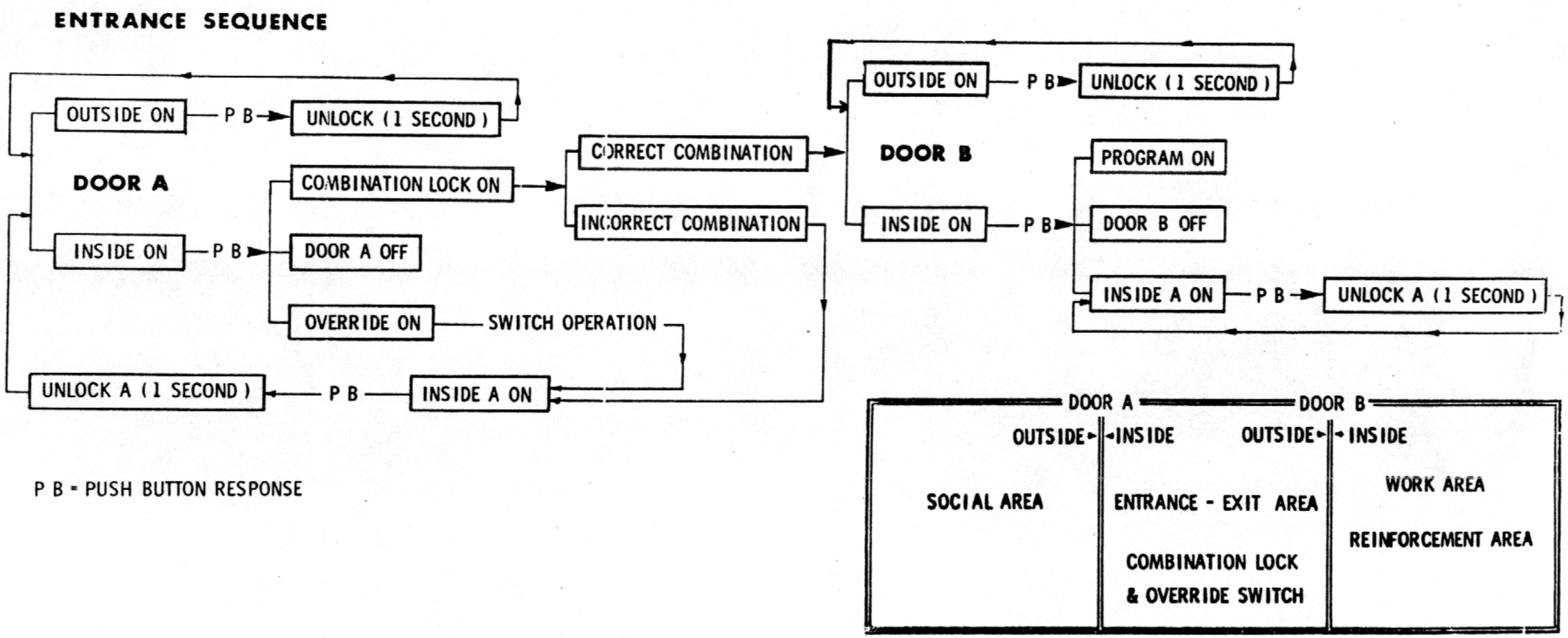


Figure 9. A flow chart of the entrance sequence. The combination lock is turned off immediately after its operation.

accompany him into the work area.

Figure 10 is a schematic illustration of an exit sequence. The exit sequence is a simple reversal of the entrance sequence, with the elimination of the combination lock and override option. An external exit command turns door B on, in the exit sequence, and the inside of door A off. Responses on the inside push button of door B unlock the door for 1 second. The first response on the outside push button turns off door B and the inside of door A on. The first response on the inside of door A unlocks the door for 1 second. At the end of this period, or when the door is closed, both sides of door A are on, and the traffic pattern is at the beginning of the entrance sequence. Responses on the outside of door A unlock it, and responses on the inside of door A turn on the discriminative stimuli associated with the combination lock and override switch.

Pretraining procedures and adaptation to the chamber.--Preliminary training is done in a 2 by 2 by 4 ft. chamber divided into two equal areas by an automatic door. On one side of the door there is a work panel and feeder panel, and on the other side there is a combination lock and a feeder panel.

The animal is introduced to one side of the chamber and allowed about 24 hours to adapt to this situation. No food is delivered during this time. A feeder is then attached to the feeder panel in the chamber and the discriminative stimuli (the light and buzzer), which are to control approach to the panel, are turned on. Each depression of the lever switch now results in delivery of the food pellet. Several free pellets are first delivered to the animal. Normally the animal finds these pellets and learns to operate the switch within a few minutes. From that point on, the buzzer and light on the feeder panel are used as conditioned reinforcers which together with food reinforcers are used to build and maintain the rest of the repertoire. With the exception of a small fruit supplement, all the food the animal receives is a function of the programmed consequences of his behavior.

The subject is trained to operate the push button on the automatic door. This particular behavior is the most difficult to shape, since the topography of the response is relatively foreign to the baboon. However, shaping can be accomplished within several hours. Once the animal has learned to operate the push button successfully, the sound of the solenoid door lock is paired with the push button response. If the animal does not investigate the door, and open it, the door may be held open for him. Then the buzzer and light of the feeder panel located on the opposite side of the training chamber is paired with the door on signal. The animal very rapidly learns to go through the door and go to and operate the feeder panel on the other side. An additional member is then added to the chain. The animal most now close the door, and push the push button on the other side. This response turns on the feeder panel. At this point the animal can be run overnight, and usually by the next morning will be "shuttling" back and forth in the training

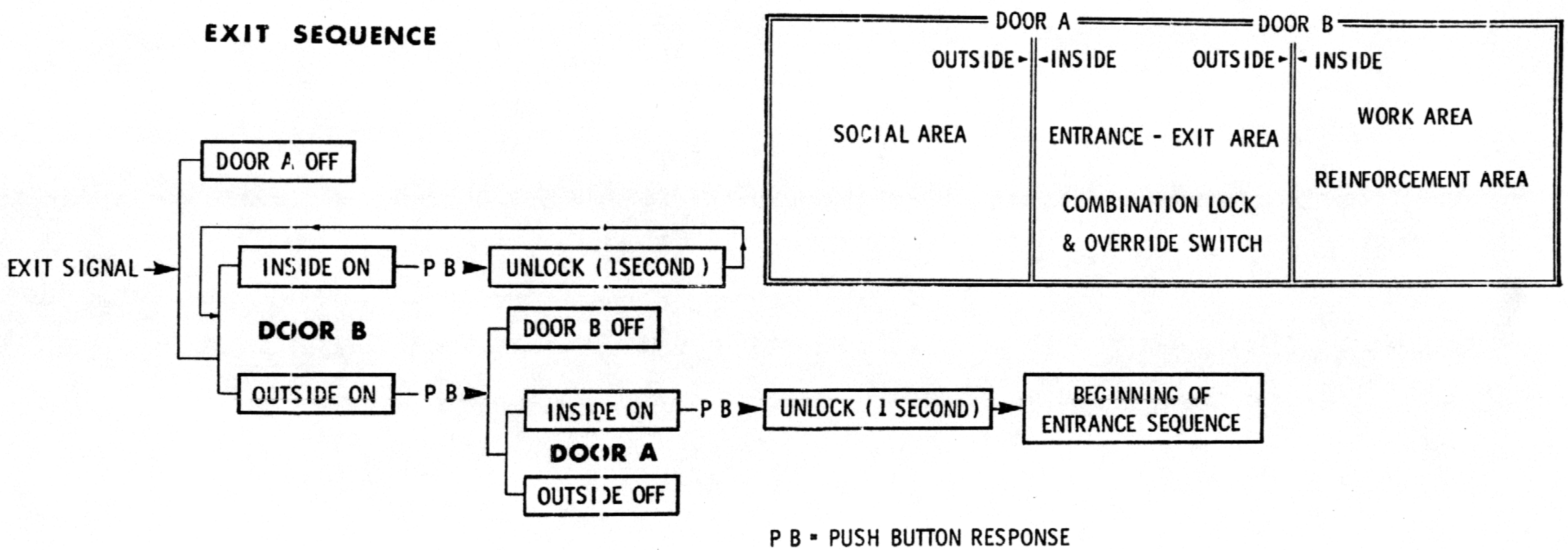


Figure 10. A flow chart of the exit sequence.

chamber.

The animal is then trained to approach and operate the pointer on the combination lock. The animal is first trained to move the pointer to a position approximating the one which has been assigned to him. The output from his position on the combination lock is fed to a clock which has a broad range of small steps leading up to five seconds. The animal is initially required to hold the pointer at his position on the combination lock for about 0.05 seconds. This value is large enough that the animal cannot sweep the pointer of the combination lock back and forth across his position, but must hesitate slightly at that position. The duration of this "hold" is gradually increased. Concurrently the approach and operation of the combination lock is brought under the discriminative control of the pilot light. Following each successful operation of the combination lock it is turned off for approximately one to three minutes. The duration of this time-out period is arbitrary, and is allowed to vary in a reasonable manner with the animal's performance. It is additionally specified that any operation of the combination lock when the pilot light is off resets this timer. The introduction of these time-out periods at an early stage of training brings about rapid stimulus control, not only by the pilot light, but also by the particular light that is associated with the animal's position on the combination lock.

The animal is normally trained to operate the work panel following the completion of the other members of the repertoire. By this time the subject has had such extended experience in the operation of lever switches that shaping of this response is either very rapid or unnecessary. Occasionally it has been necessary to remove lever switches so the animal does not learn to respond on more than one switch at one time.

In its final form, all the components of the repertoire are chained and the animal is forced to run through them successively. For example, following the completion of 50 responses on one of the lever switches on the work panel the animal is permitted to operate the feeder one or more times. At the completion of the feeder cycle a small light, which will control the opportunity to exit in the large cage, is turned on. Five responses on its associated ("exit") lever switch produce a door on signal. When the animal has successfully negotiated the door, i.e., has made a response on the push button on the other side of the door, the combination lock is turned on. Completion of this requirement turns on the feeder. Completion of the feeder cycle then begins a time-out period, following which the combination lock is turned on again. Correct operation of the combination lock now produces the door on signal and the chain begins again. Normally the animal is allowed to work on this set of activities for several days. Following this he is placed in the larger cage.

The animal is removed from the pretraining chamber and placed directly in the cubicle which will be his work chamber. The repertoire necessary for the normal traffic pattern is then reestablished. Procedures similar to those used in the pretraining cubicle are employed with two exceptions. The amount of time spent at any one condition approximating the final performance is quite small. The introduction of the combination lock in the large chamber is delayed, and consequently the animal is not allowed into the social area with the other animals for several days following his initial introduction into the large cage. The animal is forced to press the door button to turn on a feeder panel. Following this the push button response on the inside of the door turns on the feeder panel. Operation of the feeder is followed by a door on signal. The animal then moves back and forth from his work cubicle into his entrance-exit cubicle. The animal is now required to respond to a work switch with food used for reinforcement. The number of responses required on the work switch is gradually increased and responses on the exit switch are added to the chain. When the combination lock is introduced, the duration of the hold period is gradually raised to five seconds. Within two to three days the animal usually has a repertoire sufficient to be permitted free access to the social area.

## Some Advantages of Automated Multi-Animal Environments

The use of automated multi-animal environments makes it unnecessary to handle or transfer the animals for any reason. General maintenance of the cage is carried out by using automatic doors to isolate the subjects. The subjects are never restrained or confined, and the social area provides the opportunity for exercise and social contact with other animals. The large floor area, covered with wood shavings, dries feces and urine quickly, thereby reducing odor and bacterial growth. Most often the cage is cleaned simply by installing fresh shavings every one or two weeks.

Almost any kind of experimental design may be used in these chambers. In our laboratory, experiments have been performed which required fixed sessions and known deprivation levels. In these experiments, subjects were either given access to the social area between experimental sessions, or were held in their chambers during time-cut periods. In the latter case the social area was used simply as an exercise area, and as a place to "keep" the animal if it was necessary to repair the work cubicle. If, however, the opportunity to exit is used as a reinforcer, supporting the animal's performance in the work area, it is possible to conduct experiments with two mutually exclusive and independent reinforcers.

We have found that the opportunity to enter the social area is a powerful reinforcer, and can be used to maintain high levels of responding. Stable and cohesive behavior has been maintained with 800 and more responses required for each reinforcement. In concurrent situations, it appears possible to make either the performance reinforced with food, or the performance reinforced with the opportunity to exit, pre-potent over the other (Randolph & Ferster, 1966). These data are the basis for a series of experiments on "self-control" which are currently in progress. Other experiments are in progress in which the opportunity to exit is being used to support performances which are weakly maintained by food reinforcement. For example, if the opportunity to exit is made concurrent with the delay stimuli in a delay of reinforcement paradigm, these stimuli are stronger reinforcers than they are when the opportunity to exit occurs at the end of the delay chain.

We have also found that the length of time the animal spends in the social area, the amount of time it takes for him to enter the work chamber, and the time he spends eating his food in that chamber can also be a function of the programmed contingencies in the work cubicle. The use of this set of dependent variables allows the concurrent study of a larger number of variables than is normally possible in a small chamber. In most of our experiments there are no experimental "sessions." The cage runs continuously with a brief interruption in the morning while the day's data are recorded. At least some aspect of each subject's behavior is always under observation and consequently a relatively continuous picture of the effects of the experimental conditions may be obtained. The environment also appears to be an excellent vehicle for the study of social relationships occuring between two or more animals, and for synthesizing these relationships.

Once the behavior required by the traffic pattern has been established the animals go through the chain in a very routine and highly precise manner. All our observations suggest that this procedure might produce a very flexible and useful technique to handle much larger groups of primates for both experimental purposes and general maintenance.

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# PRIMATE INFANTICIDE: A NOTE AND A REQUEST FOR INFORMATION

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The literature on the social relations of macaques and baboons has many references to the protectiveness of adult males toward infants (Mason, 1965). Recently, however, during an experiment on the social relations of _irus_ macaques, I inadvertently filmed an infanticide by an adult male. The experimental procedure had called for a series of dyadic interactions between males and females. In order to control for familiarity, each male was first observed with his female cagemate before he was observed with a strange female. Since this particular male's cagemate had an infant, another female with an infant was chosen to be his stranger. The observations were made in a special observation cage into which the male and female were released almost simultaneously.

When the male was paired with his own female, he displayed the pattern of behavior that is typical of the observation situation: he mounted the female briefly and then set about to explore his surroundings. The infant he ignored completely. When, on the other hand, he was placed with the unfamiliar female, he behaved very differently. After a brief attempt at mounting, he attacked the infant where it lay clutched to its mother's ventral surface. When the mother struggled and attempted to get away, he pinned her on her back and gnawed at the infant. This attack had many surprising characteristics: (1) _The male was not a particularly dangerous male_. Although a very large animal with very large canine teeth, this male had never done serious harm to another animal, although he had been paired repeatedly with animals of every age and description. He fought less frequently than the average male and had tended always to direct his aggression toward other adult males, not toward females or young animals. (2) _His attack was immediate_. The male did not explore, did not hesitate; his teeth were into the infant within 5 seconds of the time he first saw it. (3) _The attack was very intense_. The male could not be deterred from his attack by the methods normally effective in breaking up a serious fight. In the 15 seconds of the attack, the male made three different punctures of the infant's brain case with his canine teeth: one between the infant's jaws and through the roof of its mouth, one just in front of the external ear, and the third just behind the external ear. (4) _The attack was selective_. The male attacked this infant but did not attack the infant of his cagemate when they were together moments before. (5) _The attack was circumscribed_. The only injuries to the infant were the three punctures mentioned above and superficial damage to the infant's face apparently made by the male's incisor teeth as he administered the middle canine puncture. The infant's limbs and body were intact.

Such an attack is almost unheard of in wild baboons or macaques. Serious damage to infants has been reported in a confined group of hamadryus baboons (Zuckerman, 1932) and recently in a wild population of langur monkeys (Sugiyama, 1967). Sugiyama makes the interesting observation that infanticides by male langurs occurred when a male took over another male's group. The new proprietor of the group would set about to kill the infants of the former proprietor. From the point of view of sexual selection, such attacks by males taking over a group are very advantageous to the male because, as Sugiyama points out, "loss of an infant has the effect of advancing the estrus of the female."

For these and other theoretical reasons, infanticides particularly by male monkeys are very interesting. If other investigators will send me accounts of infanticides they may have observed, I will collect them and summarize them in a future issue of the Newsletter. I am particularly interested in the previous history of the relationship between the male, the mother, and the attacked infant, in the method of attack, its duration, and in the location of damage to the infant.

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Sugiyama, Y. Social organization of hunuman langurs. In Altmann, S. A. (Ed.), Social communication among primates. Chicago: Univ. Chicago Press, 1967.

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PRIMATE NOTES FROM THE SAN FRANCISCO ZOOLOGICAL GARDENS

A colony of squirrel monkeys (*Saimiri sciureus*) has recently been established on an outdoor island. We thought the colony would be successfully established without artificial heat since the animals were provided with a large shelter and were released on the island on April 14, 1967, when the temperatures were warmer than those recorded by Sharpe and Otis (Lab. prim. Newsltr, 1966, 5 [No. 1], 5-6). However, nine animals out of 21 were lost during the week following an unusually heavy rainy period. The shelter was then heated by means of a kerosene heater and no more losses were recorded.

A male chimpanzee, "Hack," at our zoo is diabetic and is currently being treated satisfactorily with daily oral ingestion of 250 mg. of Diabinese (chlorpropamide).

An apparently notable record is the birth on October 31, 1966, of a black white-handed gibbon (*Hylobates lar*) to the same parents which raised a baby born to them on June 17, 1965. Parents and both young are all together in the same enclosure and have been continuously. Apparently this is the shortest interval of births recorded.--Ronald T. Reuther, San Francisco Zoological Gardens.

# SELF-ANOINTING IN PRIMATES WITH SPECIAL REFERENCE TO CAPUCHINS (CEBUS)

W. C. Osman Hill

Yerkes Regional Primate Research Center, Emory University

In a recent issue of Monkey Business (May, 1967), the official organ of the Simian Society of America, the following question was put by a correspondent to the Society's veterinary consultant: "My two-year-old female cinnamon capuchin is in good health. Today she did something new; she took a piece of orange and rubbed herself all over with it (leaving her rather sticky and matted). Shortly after that she stole an onion from the kitchen and ate it, rubbing herself with the pieces as she ate and crying all the while. Is this a common habit or does it indicate a diet or other problem which might affect her skin or coat" (p. 11)?

Neither the veterinary consultant nor the curator of a large zoo with whom the consultant had checked had heard of this behavior. There is, in fact, very extensive literature on this peculiar behavioral pattern which goes by the name of "self-anointing" [a term applied by Herter (1938)] and which is akin to the "anting" behavior frequently observed in some avian species.

A state of what appears to be intense excitement seems to be induced by certain odorous or irritant substances when rubbed on the skin, the result evidently of stimulation of certain cutaneous nerve-endings. Different species, and indeed different individuals, respond to different stimulant agents. In birds this is commonly the bites of ants, or of the formic acid these secrete. In capuchins numerous stimulants have been recorded, e.g., onions, alcohol, ammonia, eau-de-cologne, oil of lavender, orange juice (Nolte, 1958), spiders, grass-hoppers and other insects, lighted cigarettes (Hill, 1960). Knowledge of this strange behavior goes back even as far as Linnaeus (1754) who observed a C. apella scattering snuff upon himself. The phenomenon has also been commented upon by Schomburgk (1840), Brehm (1916), and Fiedler (1957).

A kindred phenomenon is that reported by me (Hill, 1944) in an adult male Drill (Mandrillus leucophaeus) who salivated profusely and became frantically excited when presented with the leaves and twigs of the mango (Mangifera indica), which carry a peculiar odoriferous juice. The material was rubbed over the salivating mouth and then to the characteristic pectoral cutaneous glandular area (the presence of the suspected gland was confirmed histologically later; Hill, 1954), with rapid alternations between the two sites and subsequent spreading of saliva over the body to the accompaniment of massive limb, body, and head movements.

I have summarized the literature on the phenomenon as it concerns

*Cebus* monkeys in volume IV of my series of monographs (Hill, 1954, p. 387), with additional personal experiences.

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Nolte, A. Beobachtungen über das Instinktverhalten von Kapuzineraffen (*Cebus apella* L.) in der Gefangenschaft. *Behaviour*, 1958, *13*, 183-207.

Schomburgk, R. H. *Reisen in Britisch Guyana*. Leipzig, 1840.


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## SYMPOSIUM ON PRIMATE LOCOMOTION PUBLISHED

*The American Journal of Physical Anthropology* has published, as its March, 1967, issue (Volume 26, No. 2), the papers presented at the Symposium on Primate Locomotion held at Davis, California, in 1965. To make this issue available to primatologists who are not regular subscribers of the *Journal*, several hundred extra copies have been printed. The price is $4.00 a copy, and the issue should be ordered directly from the publisher: The Wistar Institute of Anatomy and Biology, 36th Street at Spruce, Philadelphia, Pennsylvania 19104.

## MEETING ANNOUNCEMENTS:
## EUROPEAN SYMPOSIUM ON USE OF NONHUMAN PRIMATES IN MEDICAL RESEARCH

This meeting will be held December 11-14, 1967, under the auspices of the World Health Organization, INSRM, and the Faculty of Medicine, University of Lyon, at the Fondation Mérieux, Lyon. The provisional program is as follows:

I. <u>Husbandry and technology</u>

1. The selection of primate species most suitable for various uses. 2. Availability and cost; housing and caging; nutrition and feeding; techniques of handling; injection, taking specimens, measurements: (a) Rhesus and other macaques, (b) Cercopithecus, (c) Baboons, (d) South American species, (e) Apes. 3. Capturing in the wild, shipping and distributing. 4. Breeding. 5. Tranquilization, anesthesia, and general surgical procedures. 6. Telemetering. 7. Diseases and zoonotic aspects of them.

II. <u>Résumé of some recent comparative research in primates</u>

8. Cardiovascular diseases. 9. Psychology. 10. Organ transplantation, blood and tissue immunology. 11. Human virus diseases. 12. Cancer.

There will be simultaneous interpretation in English and French.

Greatest emphasis will be put on Part I of the program where the subjects will be dealt with in detail. Part II will be of a more general nature to convey an impression of current trends and future possibilities in the use of primates in medical research.

Those interested should ask for invitations either from the Veterinary Public Health Unit, World Health Organization, Geneva, Switzerland, or Fondation Mérieux, 17 rue Bourgelat, Lyon 2e, France.

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

## Books

Social communication among primates. Altmann, S. A. (Ed.) (Yerkes Reg. Primate Res. Center, Atlanta, Ga. 30322) Chicago: U. Chicago Press, 1967.

These are the published proceedings of the AAAS symposium on Communication and Social Interactions in Primates. Among the topics discussed are sexual behavior, parental care and infant development, aggression and submissiveness, social systems, communication processes, and causal mechanisms. Contributors to this symposium include anthropologists, linguists, mathematicians, neurologists, psychiatrists, psychologists, and zoologists.

Lemur behavior: A Madagascar field study. Jolly, A. (Dept. Applied Economics, Cambridge U., Cambridge, U. K.) Chicago: U. Chicago Press, 1966.

A description of the ecology and social behavior of 2 species of lemurs--Lemur catta and Propithecus verreauxi--including their individual behavior, relations with other species, troop structure, feeding, sleeping, and sexual habits.

International zoo yearbook. Vol. VII. Jarvis, Caroline (Ed.) London: Zoological Society of London, 1966. (Order from: Publications Dept., The Zoological Society of London, Regent's Park, London NW1, England. Cost is $18.75.)

This year the book includes the following articles among others: Gestation periods in Lorisidae, Breeding the white-headed saki monkey, Hand-rearing a spider monkey, Breeding Humboldt's woolly monkey, Breeding the spectacled leaf monkey, Breeding the proboscis monkey, Breeding the pileated gibbon, Gestation period of the siamang, Breeding orang-utans at Fresno Zoo, Breeding the orang-utan at Tokyo Tama Zoo, Hand-rearing chimpanzee twins, San Diego Zoo's captive-born gorilla, Frankfurt Zoo's captive-born gorilla, A lemur research colony, Keeping Philippine tarsiers in a research colony, and Semi-free-ranging colonies of monkeys. 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 cap-

*References in this section without summaries have in many cases been taken directly from the Current Primate References prepared by The Primate Information Center, Regional Primate Research Center, University of Washington.

tivity. For the first time returns from the American Regional Primate Research Centers and other research institutions with rare primates have been included in the breeding and rare animal lists. Names and addresses of these organizations are given in the main zoo list.

The Zoological Record. Vol. 101 (1964 literature). London: The Zoological Society of London, 1966.

The Zoological Record is published annually in 20 sections, 18 of which record a year's literature relating to a phylum or class of the animal kingdom. Another section is devoted to Comprehensive Zoology, and the final section lists the new genera and subgenera contained in each volume. Complete volumes (20 sections) are supplied with binding bases, title pages and contents list. Sections may be ordered separately.

The Zoological Record forms a continuous bibliography and enables the searcher to trace works published over the last 100 years. Each section is divided into three indexes which interrelate, thus forming a three-way reference system. This consists of: 1. Bibliographical index arranged alphabetically under Authors. 2. Subject index arranged under broad headings such as Development; Distribution; Ecology; Evolution, Genetics and Variation; Physiology and Biochemistry; Structure; Reproduction and Sex, besides many others. 3. Systematic index which contains information relevant to a particular species or to groups of the phylum concerned, together with details of new taxa.

## Disease

Chimpanzee-associated hepatitis. Mosley, J. W., Reinhardt, H. P., & Hassler, F. R. (1600 Clifton Road, N.E., Atlanta, Ga. 30333) The Journal of the American Medical Association, 1967, 199, 695-697.

A small outbreak of hepatitis occurred in Oklahoma following contact with newly imported chimpanzees. The infection appears to have been acquired by the chimpanzees in captivity and then transmitted to the caretakers at their final destination.

Parasites in newly imported animals. Worms, M. J. (Nat. Inst. Med. Res., Mill Hill, London, N.W.7, England) Journal of the Institute of Animal Technicians, 1967, 18, 39-47.

Parasitic infection may have an adverse effect upon breeding, it may complicate behavior studies and affect the results of toxicity tests. It is important that the animal technician should recognize a parasitic infection in order to facilitate the treatment of sick animals and to prevent transmission of the parasites to other individuals or other species, including man, to which they may be pathogenic. The paper examines briefly the main groups of parasites with examples drawn from experience in the writer's laboratory over the past few years.

Acute gastric dilatation in Macaca mulatta and Macaca speciosa monkeys. Chapman, W. L., Jr. (Reg. Primate Res. Center, U. Wisconsin, Madison, Wis.) Laboratory Animal Care, 1967, 17, 130-136.

Eight cases of acute gastric dilatation in 2 species of monkeys are reviewed. Excessive food and water consumption is indicated as the predisposing factor. Clinical signs, therapy and necropsy findings are discussed.

Fibrous gingival hyperplasia of a mustache guenon monkey (Cercopithecus cephus). Sheldon, W. G. (Lab. Animal Resources Cen., Coll. Vet. Med., Texas A & M U., College Station, Texas) Laboratory Animal Care, 1967, 17, 140-143.

The occurrence of a case of fibrous gingival hyperplasia in an adult mustache guenon monkey is described. The large, firm, pale-pink fibrous gingival masses were surgically removed, and the animal was observed for 15 months after the operation. Recurrence of the hyperplastic gingiva was limited to a small area in the region of the upper right first molar. The histological appearance of the excised gingiva was that of relatively avascular mature fibrous tissue underlying a parakeratotic and hyperkeratotic epithelium. The rete pegs of the epithelium extended deep into the thick layer of fibrous tissue. Inflammation was not prominent except in areas of superficial local infection.

The periodontium and periodontal pathology in the howler monkey. Hall, W. B., Grupe, H. E., & Claycomb, C. K. (Dept. Periodontology, U. Oregon Dental Sch., Portland, Oregon) Archives of Oral Biology, 1967, 12, 359-365.

106 formalin fixed and 65 defleshed skulls of wild howler monkeys were surveyed grossly for evidence of periodontal disease. 16 wet specimens displayed clinically detectable pocket formation. Roentgenograms confirmed the pressence of osseous lesions. Similar bone lesions were noted in the dried skulls. 2 normal animals were studied microscopically. All areas of gross pathology, periodontal and periapical, were prepared and studied similarly. The periodontal lesions were quite similar to those seen in man, grossly, roentgenographically, and microscopically. No generalized periodontal disease, such as is commonly found in man, was noted. 2 dehiscenses and 150 fenestrations were noted in the dried skulls. The existence of these osseous defects did not appear to be related to periodontal problems. The howler monkey would appear to have distinct

advantages for future studies of periodontal disease.

Diseases of rhesus monkey. II. Small intestines. Guleria, S. S., Chakravarty, R. N., Chawla, L. S., & Chhuttani, P. N. (Inst. Post-Grad. Med. Educ. & Res., Chandigarh, Punjab, India) Journal of the Association of Physicians of India, 1966, 14, 239-242.

A study of the small intestines of 142 rhesus monkeys within a week of trapping showed 11.3% with helminthic infestations, 5.7% with protozoal infestations, and 11.3% with intussusceptions. No case of malabsorption, tuberculosis, congenital anomaly, or neoplastic disease was seen.

A comparison of vitamin $D_2$ and $D_3$ in New World primates. I. Production and regression of osteodystrophia fibrosa. Hunt, R. D., Garcia, F. G., & Hegsted, D. M. (New England Reg. Primate Res. Center, Box J, Southboro, Mass. 01772) Laboratory Animal Care, 1967, 17, 222-234.

Progressive osteodystrophia fibrosa developed in cebus monkeys (Cebus albifrons) using a purified diet containing 0.8% calcium, 0.46% phosphorus, and 2,000 IU vitamin $D_2$/kg, and in cotton-topped marmosets (Leontocebus oedipus), white-lipped tamarins (Leontocebus nigricollis), and mystax marmosets (Leontocebus mystax) fed a commercial ration containing 0.98% calcium, 0.55% phosphorus, and 2,200 IU vitamin $D_2$/kg. The disease was characterized by high serum alkaline phosphatase and characteristic lesions of osteodystrophia fibrosa. Vitamin $D_3$ at 2,000 IU/kg diet substituted in the cebus diet and provided per os at a level of 500 IU/monkey/week to the marmosets resulted in reversal of the disease process. These data demonstrate that the physiological activity of vitamin $D_2$ and $D_3$ differ in several species of New World nonhuman primates.

## Physiology and Behavior

Transferrin polymorphism and population differences in the genetic variability of chimpanzees. Goodman, M., Wisecup, W. G., Reynolds, H. H., & Kratochvil, C. H. (Dept. Microbiol., Wayne State U., Coll. Med., 1401 Rivard, Detroit, Mich.) Science, 1967, 156, 98-100.

The mycoflora of the subhuman primates. I. The flora of the oral cavity of the baboon in captivity. Al-Doory, Y. (Dept. Mycology, Southwest Found. Res. & Educ., San Antonio, Texas) Mycopatholgia et Mycologia Applicata, 1967, 31, 43-48.

Culture studies revealed that 54.3% of 70 mouth samples and 15.1% of 371 throat samples from captive male and female baboons contained yeasts. Candida albicans was found to be the highest single species isolated from the oral cavity of both sexes, with the exception of Trichosporon, which was slightly higher in the mouths of female baboons. There is a slight indication that the yeast flora of the female oral cavity is higher than that of the male. Similarly, there is a close parallelism between the oral mycoflora of human beings and that of the baboons studied.

Marmosets as laboratory animals. II. The hematology of laboratory kept marmosets. Anderson, E. T., Lewis, J. P., Passovoy, M., & Trobaugh, F. E., Jr. (Sec. Hematology, Dept. Med., Presbyterian-St. Luke's Hosp., 1753 West Congress Parkway, Chicago, Ill.) Laboratory Animal Care, 1967, 17, 30-40.

Studies have been performed on the hematopoietic system of recently captured, laboratory acclimatized marmosets. "Normal ranges" as determined in this study have been compared to the normal ranges in humans and to values found in the rhesus monkey and one other study of marmosets. The similarity of marmoset hematologic values to those of humans lends support to the thesis of using marmosets as laboratory animals suitable for use in human tumor-virus research.

Marmosets as laboratory animals. III. Blood chemistry of laboratory-kept marmosets with particular attention to liver function and structure. Holmes, A. W., Passovoy, M., & Capps, R. B. (Presbyterian-St. Luke's Hosp., Chicago, Ill.) Laboratory Animal Care, 1967, 17, 41-47.

As a part of the general evaluation of marmosets as laboratory animals their blood chemistry was investigated and compared with normal human values. Because of the particular interest of this laboratory in diseases of the liver, emphasis was placed on tests of liver structure and function.

Marmosets as laboratory animals. IV. The microbiology of laboratory kept marmosets. Deinhardt, F., Holmes, A. W., Devine, J., & Deinhardt, Jean. (Presbyterian-St. Luke's Hosp., Chicago, Ill.) Laboratory Animal Care, 1967, 17, 48-70.

The bacterial, mycotic, parasitic, and virological flora of wild-caught and laboratory acclimatized marmosets is described. The use of marmosets for experimental viral infections is also described.

Marmosets as laboratory animals. V. Blood groups of marmosets. Wiener, A. S., Moor-Jankowski, J., & Gordon, Eve B. (Office of Chief Medical Examiner of N. Y. City, Dept. Forensic Med., N.Y.U. Sch. Med., New York, N. Y.) Laboratory Animal Care, 1967, 17, 71-76.

Marmosets of various species have been tested for human-like A, B, H, and Lewis blood factors. Tests were carried out with suitably absorbed human blood grouping sera and with reagents of plant origin. Both red cells and saliva were tested for the presence of blood group substances.

Birth weight, gestational age, and type of delivery in rhesus monkeys. Fujikura, T., & Niemann, W. H. (Lab. perinatal Physiol., Nat. Inst. Neurol. Dis. Blindness, San Juan, Puerto Rico) American Journal of Obstetrics and Gynecology, 1967, 97, 76-80.

The frequency distribution of birth weights at any given gestational age spans a wide range in human newborn infants. To describe infants in whom there has been a remarkable discrepancy between birth weight and gestational age, a variety of terms have been used: intrauterine growth retardation, dysmaturity, placental insufficiency syndrome, low birth weight infants, etc. The variability in birth weights of 471 rhesus monkeys at a specific gestational age was wide, just as in human newborn infants. The variability in birth weights, as indicated by the coefficient of variation, was roughly constant regardless of gestational age, sex, and type of delivery. Since, in addition, gestational ages of these animals were presumed to be accurate because of timed matings, the variability in birth weights seems to be largely independent of environmental factors.

Hematology of the *Macaca mulatta* monkey. Melville, G. S., Jr., Whitcomb, W. H., & Martinez, R. S. (USAF Sch. Aerospace Med., Brooks AFB, Texas) Laboratory Animal Care, 1967, 17, 189-198.

## Facilities, Care, and Breeding

Vaginal cornification cycles in the squirrel monkey (*Saimiri sciurea*). Rosenblem, L. A., Nathan, T., Nelson, J., & Kaufman, I. Ch. (Downstate Med. Cen.--State U. of N. Y., New York, N. Y.) Folia Primatologica, 1967, 6, 83-91.

Vaginal smears were obtained from a group of 15 Peruvian squirrel monkeys (*Saimiri sciureus*) for periods ranging up to 21 months. Heightened levels of vaginal cornification and the attainment of an estrus criterion were most frequently observed in June and July--a period corresponding to the probable "breeding peak" season of this species in the wild. The average interval between estrus criterion levels of cornification, between the appearances of red blood cells (RBC's) in the smear, and between the appearances of spermatozoa in the smear when males were present, all pointed to the existence of a 7-8 day estrus cycle in this species during those periods of the year when actual cycling was present.

Rearing marmosets from birth by artificial laboratory techniques. Hampton, Suzanne H., & Hampton, J. K., Jr. (U. Texas, Inst. Dental Sci., 1018 Blodgett St., Houston, Texas 77025) Laboratory Animal Care, 1967, 17, 1-10.

From the offspring of a successful breeding colony of *Leontocebus* (*Saquinus*, *Oedipomidas*) *oedipus*, 7 infants were reared by artificial laboratory techniques. The diet consisted of SMA-Liquid Infant Food (Wyeth Laboratories) given via a syringe to which a silicone nipple was attached. Initially feedings were at 2-hour intervals from 7 a.m. to 11 p.m. Caloric intake increased rapidly reaching a plateau of 200-300 kilocalories per kilogram per day. The only vitamin supplement provided was Vitamin $D_3$ at levels of 1,400-4,500 I.U. per kilogram per day. An inexpensive incubator system provided control of temperature and humidity. Weaning from formula was complete at approximately 1 month. A comparison of the growth curves of artificially reared and parent reared animals show close correlation.

Marmosets as laboratory animals. I. Care of marmosets in the laboratory, pathology and outline of statistical evaluation of data. Deinhardt, Jean B., Devine, J., Passovoy, M., Pohlman, R., & Deinhardt, F. (Presbyterian-St. Luke's Hosp., Chicago, Illinois) Laboratory Animal Care, 1967, 17, 11-29.

The general animal husbandry, the evaluation of biological baseline values and the pathology of wild-caught and laboratory kept marmosets is described.

Reproduction of green monkeys (Cercopithecus aethiops pygerythrus). Chernyshov, V. I. (Inst. Poliomyelitis & Virus Encephalitis, A. M. N., Moscow, USSR) Vop. Antrop., 1966, 23, 144.

Sexual performance index of male rhesus monkeys. Michael, R. P. (Primate Res. Cen., Instit. Psychiatry, Bethlem Royal Hosp., Monks Orchard Road, Beckenham, Kent, England) Nature (London), 1967, 214, 425.

The estrous cycle of nonhuman primates: a review of the literature. Lang, C. M. (Dept. Lab. Animal Med., Bowman Gray Sch. Med., Wake Forest College, Winston-Salem, N. C.) Laboratory Animal Care, 1967, 17, 172-179.

The literature on the estrous cycle of primates is reviewed, and a bibliography is presented.

A technique for the collection of semen from squirrel monkeys (Saimiri sciureus) by electro-ejaculation. Lang, C. M. (Dept. Lab. Animal Med., Bowman Gray Sch. Med., Wake Forest College, Winston-Salem, N. C.) Laboratory Animal Care, 1967, 17, 218-221.

## Ecology, Field Studies, and Taxonomy

Ecology and taxonomy of the gorilla. Groves, C. P. (Unit of Primatology & Human Evolution, Royal Free Hosp. Sch. Med., London, W.C.1, England) Nature (London), 1967, 213, 890-893.

The writer concludes that the gorilla forms only a single species, whose characters overlap in the different races. There are three valid sub-species, at least two of which have ecologically differing demes. They are as follows: Gorilla gorilla gorilla Savage and Wyman, 1847 (western gorilla), Gorilla gorilla manyema Rothschild, 1908 (eastern lowland gorilla), Gorilla gorilla beringei Matschie, 1903 (eastern mountain gorilla).

Deciphering primate phylogeny from macromolecular specificities. Goodman, M. (Dept. Anatomy, Wayne State U., Coll. Med., Detroit, Mich.) American Journal of Physical Anthropology, 1967, 26, 255-276.

A problem in deciphering primate phylogeny, morphological convergence between different evolutionary lines, can be overcome by species comparisons of proteins, macromolecules with specificities closely linked to the genetic code in DNA. Various chemical, electrophoretic, and immunological data on serum and tissue proteins in primates are reviewed with respect to their phylogenetic significance. Much of this data deals with protein specificities in the Hominoidea and depicts a particularly close genetic relationship between man and the African apes. Hominoidea, Cercopithecoidea, Ceboidea, and Lorisoidea are characterized by their proteins as monophyletic or natural taxa, even though the conventional subdivisions within several of these superfamilies are not in complete accord with the protein analyses. The protein evidence supports the conventional grouping of Cercopithecoidea with Hominoidea in the infraorder Catarrhini and the grouping of Catarrhini and Platyrrhini (Ceboidea) in the suborder Anthropoidea. Lemuroidea and Lorisoidea appear to be closer to one another than to either Tupaioidea or Anthropoidea and closer to the Anthropoidea than to the Tupaioidea. Comparisons of primate DNA's by Hoyer and coworkers are demonstrating genetic affinities among primates which agree with those deduced from the comparison of protein specificities. Species differences and similarities in the relative amounts of different protein macromolecules reflect the grade relationships of primates, but, unlike the comparisons of amino-acid sequences or antigenic specificities, are not reliable indicators of phyletic affinities. Data on the ratios of M(uscle) to H(eart) type lactate dehydrogenase in a series of primate brains provides a biochemical example of the concept that there are "lower" (primitive) and "higher" (advanced) grades of evolutionary development among the extant primates.

## Instruments and Techniques

Technique for radio telemetry of blood-flow velocity from unrestrained animals. Franklin, D. E., Watson, N. W., Pierson, K. E., & Van Citters. R. L. (Biomed. Eng., Scripps Clinic Res. Found., La Jolla, Calif.) The American Journal of Medical Electronics, 1966, 5, 24-28.

This report describes the circuitry and operation of a miniature telemetry blood flowmeter based on the Doppler principle. A plastic cylinder containing lead-zirconate sound-emitting and sensing crystals is clamped about a blood vessel to serve as the transducer. Five-megacycle sound is beamed from one crystal diagonally through the vessel wall into the blood stream. Part of the sound is backscattered from the blood and excites the second crystal. This signal is amplified and detected. The difference between transmitted and received frequencies, i.e., the Doppler shift of backscattered sound, is a measure of the blood velocity. The difference frequency modulates a VHF oscillator so that an FM/FM signal is radiated. When the signal is received remotely, the modulating frequency is recovered and analyzed in terms of frequency to determine blood velocity. The telemetry range is over 300 meters. The flowmeter has been used for measurement of flow through the major vessels of various animals (dogs, seals, baboons, fish, alligators, birds, horses, and turtles) in both acute and chronic preparations.

A new technique for sampling bone marrow in monkeys. Switzer, J. W. (Bionetics Res. Labs, Inc., 101 West Jefferson St., Falls Church, Va.) Laboratory Animal Care, 1967, 17, 255-260.

A technique is described for obtaining bone marrow aspiration samples from the ischial shaft in simian species. The use of Procaine HCl for local anesthesia and the use of proper restraint eliminates the need for general anesthesia. Bone marrow slides are prepared by allowing a drop of aspirated material to run down the slide, leaving bone marrow particles adhering to the surface of the glass slide. A modified Wright-Giemsa stain is used to stain the preparations. The marrow aspiration technique presented has the advantage over previously described techniques in eliminating the requirement for general anesthesia and is rapidly performed under general laboratory conditions.

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