sponded to the administration of antigen.

Histamine (0.1 to 1 μg/ml) caused a sustained shortening of the denervated diaphragmatic muscle from both sensitized and nonsensitized animals. Smaller contractions were also recorded upon the administration of bradykinin (1 μg/ml) and serotonin (10 to 100 μg/ml). The lack of a stimulant action of histamine in Dale and Gaddum's (*1*) experiments on the denervated hemidiaphragm of young kittens can be attributed to the lower sensitivity of cat tissues to this compound. Similar differences between species would account for the fact that denervated rat diaphragm does not respond either to histamine, serotonin, or bradykinin (*3*).

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References and Notes

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Primate Research and Systematics

The neglect of some basic aspects of primatology—in particular, taxonomy and zoogeography—may be illustrated by reference to two recent communications, one on mirror display in squirrel monkeys [P. D. MacLean, *Science* **146**, 950 (1964)], the other entitled "Primate biology: planning meeting" (L. Carmichael and A. J. Riopelle, *ibid.*, p. 1078).

MacLean identifies his animals as "squirrel monkeys (*Saimiri sciureus*)" and goes on to say that they "comprise several closely related species." Perhaps he meant subspecies. In any case, he distinguishes two kinds of male squirrel monkeys. One kind consistently displays an erect phallus to its reflection in a mirror and is marked by a facial pattern described as "Gothic." The other scores very low in phallic response to reflection and has a so-called "Roman" facial pattern. The author is unable to determine the taxonomic relationship between the two kinds of monkeys and can only speculate on their respective places of origin in tropical America. He does, however, provide a photograph of each facial type. Finally, the variable narcissistic tendencies of the monkeys lead him to observe that "It will be of interest to learn whether or not there has existed any environmental difference between the Gothic and Roman type monkeys in regard to ancestral exposure to reflecting pools and streams from overhanging boughs." It would, of course, be more germane to learn the history of the experimental animals from the time and place of capture to the time of the first laboratory experiment performed on them.

Any interpretation of MacLean's findings, assuming the unlikely absence of extraneous conditioning factors, depends on a knowledge of the genetic relationship between the two kinds of squirrel monkeys. Should they prove to be members of different clans of the same race, one explanation may apply. Should they represent different subspecies or different species, then other explanations may well be in order. Unfortunately, there is no modern taxonomic revision for squirrel monkeys, despite the fact that these animals are widely used in anatomical, physiological, medical, and behavioral research.

The second communication deals with proposed cooperative studies on primate biology by American and Japanese scientists. The authors list three areas for joint studies agreed upon by participants in the meeting. These are "(i) comparative studies of inter- and intra-species characteristics of primates, (ii) anatomical, physiological, and behavioral studies of primates, and (iii) studies of the care and diseases of free and captive primates." The first field of study holds great promise for biologists, but its scope appears to be limited to such primate characteristics as social organization, communication, vocalization, and interspecies ecology. There is no evident concern for the reliable determination of the *kind* of animal, that is, the species or subspecies, whose "characteristics," anatomy, diseases, and so on are under study. Basic research on the origin, evolution, and dispersal of primates seems to be even more remote from the objectives of the proposed program.

To many Japanese primatologists, systematic studies may be academic. There is one native species of macaque in Japan, and most primatological work in that country has been done on that animal. In contrast, American laboratories and those zoological gardens where biological research is conducted house primates representing virtually every living family, a majority of the genera, and scores, perhaps hundreds, of species and subspecies. Most experimentalists identify these primates by the trade or vernacular names passed on to them by animal dealers. The names used may be no more specific than lemur, monkey, or marmoset. The kinds of apes are generally recognized, but except for the orangutan, there is more confusion than certainty in distinguishing between what may be considered a species and what a race in gorillas, chimpanzees, and gibbons. The place of origin of an experimental animal is often recorded as Miami, New York, San Francisco, or whatever U.S. port of entry is shown on the bill of lading. Not often is the animal's true provenance more precisely known than as Africa, Asia, or South America.

Much of the carelessness, confusion, or indifference stems from an unawareness of the importance of taxonomy and zoogeography in the evaluation of data derived from wild animals of unknown genetic stock. Many scientists may regard their laboratory primates as nothing more than chemical or physiological containers of a particular tissue, organ, or system needed in research, or they may treat the animals as mere vehicles for biochemical or microbiological experiments. These scientists are laudably meticulous about what is put into these living media, what is removed from them, and how. Few, however, evince more than a passing interest in these captive containers or vehicles as identifiable organic elements of an ecosystem. Many existing laboratory colonies of primates used in highly specific research projects are stocked with one or more unidentified species or subspecies and undergo, through deaths and replacements, uncontrolled changes in their taxonomic content. These taxonomic turnovers extend to the microfauna and microflora living in and on the host species. It would be folly to believe that no alteration or distortion of data and experimental results is caused by this state of affairs.

Many scientific discoveries in the laboratory cannot be repeated, and others are lost for want of a reliable

identification and the correct technical name of the experimental animals. Aggravating the situation is the lack of comprehensive and authoritative taxonomic revisions of the large majority of living primate species. The taxonomy and scientific nomenclature of most species of primates used in laboratory research are chaotic. The fact that the number of competent specialists engaged in systematic research on primates is very small does not enhance the outlook for improvement.

According to Carmichael and Riopelle, since 1930 "primate studies in the United States have become wide in scope and breadth in terms both of the number of scholars participating in them and of the academic disciplines they represent. The recent founding of seven regional primate research centers with full financial support from the United States Government gives a prospect of rapid growth of primate studies." A careful study of the proposed research program of each of these seven primate centers (*1*) reveals no provision or stipulation for the study of primate systematics. It seems incredible that the government would spend millions of dollars for the establishment and operation of seven huge primate centers and millions more for their respective research programs but not one cent for satisfying the elementary and prior need for an authoritative determination of the kinds of animals used in research.

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1. Fact Sheet, 24 Oct. 1963, Regional Primate Research Center Program, Animal Resources Branch, Division of Research Facilities and Resources, National Institutes of Health, Bethesda, Md.

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It is to be hoped that Hershkovitz's letter will stimulate further interest in the important problem of the taxonomy and zoogeography pertaining to animals used in research. At the very least one should be able to determine the geographical origin of animals procured for research. As I pointed out, the present conditions under which squirrel monkeys are obtained commercially make their origin uncertain. Taxonomists who have attempted to help us identify our monkeys have felt defeated from the beginning by our inability to specify the locality of their capture. I should point out that in stating that squirrel monkeys "comprise several closely related species" I cited W. C. Osman Hill as the authority and had no personal knowledge on which to base this conclusion. It is to be hoped that in the near future a group of interested scientists will attempt to see what can be done to correct the present haphazard manner in which imported animals are trapped and traded commercially.

I would emphasize that in the future more than the conventional taxonomical descriptions will be required in arriving at a full understanding of relationships among species. The mirror-display study illustrates, as ethologists have emphasized, that an animal's behavior may in itself be an important consideration in this matter. The difference in the display in the two types of squirrel monkeys described provides a behavioral distinction that would have been overlooked by ordinary methods. Contrary to what Hershkovitz suggests, the various commercial sources of our animals make it unlikely that "conditioning factors" from the time of capture could alone account for the observed behavioral differences.

Nor can one stop short of other forms of basic description that have been neglected in the past. Anyone comparing, for example, the anatomical organization of the brains of the hyrax and the elephant would seriously question the inclination of some authorities to group these animals together. A recent neuroanatomical study by Jane *et al.* [*Science* **147**, 153 (1965)] has uncovered evidence that is counter to the long-held belief that the tree shrew represents a primitive form of primate. The neurochemist and the neuropharmacologist are reminded every day of significant biochemical differences existing not only among species but also among strains. These are additional reasons for strongly supporting Hershkovitz's plea that the new primate centers take advantage of their unique opportunities for "the study of primate systematics."

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