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IMITATION IN MONKEYS.

BY

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*From the Harvard Psychological Laboratory.*

WITH THIRTEEN FIGURES.

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I. INTRODUCTORY STATEMENTS.

1. *Statement of Problem.* Popular opinion has generally attributed to monkeys the ability to learn by imitation. As will appear later, experimental evidence on the matter has been of a conflicting nature, but in the main it has not supported the popular belief. The general problem of imitation presents itself in the form of two questions: Do monkeys imitate human beings? and Do they imitate one another? It is conceivable and, indeed, quite probable that an animal which fails to copy the acts of persons, may yet imitate individuals of its own species. In the native state, monkeys must have innumerable opportunities to imitate one another, whereas they rarely, if ever, have opportunity to imitate human beings. Further-

more, a *monkey* lifting a latch is a very different stimulus for an observing monkey from a *person* lifting the same latch. In view of these considerations it is important in an experimental study of imitation in monkeys to deal separately with the two questions proposed above. The first question, Do monkeys imitate human beings? is only indirectly related to the natural activities of the animals; the second, Do they imitate one another? is extremely important for an understanding of the behavior and mental life of monkeys. To discover in what ways certain species of monkeys are influenced by one another's acts has been the chief aim of the investigation which I have here to report.

2. *History of Present Investigation.* The investigation was begun in the Harvard Psychological Laboratory in October, 1907. From that time until June, 1908, the experimenter devoted himself (a) to studying the behavior of three *Cebus* monkeys; (b) to making experiments with these individuals for the purpose of developing methods of testing imitative ability, and (c) to devising and constructing apparatus for experimental work.

In June, 1908, the investigation was transferred to the New York Zoölogical Park in order to make use of the large collection of monkeys available there. The apparatus which had been built in Cambridge, and two of the *Cebus* monkeys which had been used in the preliminary experiments were taken to the Park. Here, under peculiarly favorable conditions the investigation was continued until September. Well-prepared apparatus and methods of experimental procedure, the fine collection of animals and the excellent local conditions provided by those in charge of the Park, greatly facilitated the work and within the short space of ten weeks much was accomplished in the way of results.

3. *The Work of Other Investigators.*—Noteworthy observations concerning the imitative ability of monkeys have been made under experimental conditions by Thorndike<sup>1</sup>, by Kinnaman<sup>2</sup>, by Hob-

<sup>1</sup>THORNDIKE, EDWARD L. The Mental Life of the Monkeys. *Psychological Review, Monograph Supplement*, vol. 3, no. 5, 57 pp. 1901.

<sup>2</sup>KINNAMAN, A. J. Mental Life of Two *Macacus Rhesus* Monkeys in Captivity. *American Journal of Psychology*, vol. 13, pp. 98-148; 173-218. 1902.

house,<sup>3</sup> and by Watson.<sup>4</sup> In the main these observations are but indirectly related to the present investigation, for they are largely concerned with the animal's ability to copy the acts of human beings. On this ground, the work of Hobhouse, which gave positive results, may be excluded from this discussion. The other three investigators, who studied the tendency of monkeys to imitate one another, used, in one form or another, the problem method. One monkey was taught to get food by manipulating a mechanical device; then another monkey was allowed to learn the act by watching the trained animal perform. None of the investigators has given the problem an extended study, since the observations in this particular were incidental to studies of wider scope.

Thorndike reports a series of five experiments on a Cebus monkey. This animal, "No. 3," was, at the time of the experiments, "on terms of war" with No. 1, the animal he was to imitate. In none of the imitation tests did "No. 3" learn to do the act. Thorndike concludes: "There is clearly no evidence here of any imitation of No. 1 by No. 3. There was also apparently nothing like purposive watching on the part of No. 3."<sup>5</sup> "This lack of any special curiosity about the doings of their own species characterized the general behavior of all three of my monkeys and in itself lessens the probability that they learn much from one another."<sup>6</sup>

Kinnaman observed two cases where the conduct of a male rhesus caused the female to learn an act. The problem was to get food by manipulating a mechanism—in one case, the pulling of a plug, in the other, the bearing down of a lever. In each case, the female was given opportunity to get food but failed. The male was then allowed to get food while she was present and watching. In each case she went at once, after seeing the male get food, and operated the mechanism and repeated the performance numerous times later. Kinnaman says: "Here we have a copy in the form of an act. It was copied almost in detail, and that, too, so far as the place of

<sup>3</sup>HOBHOUSE, L. T. *Mind in Evolution*. Chap. X. London. 1901.

<sup>4</sup>WATSON, JOHN B. *Imitation in Monkeys*. *Psychological Bulletin*, vol. 5, pp. 169-178. 1908.

<sup>5</sup>P. 40.

<sup>6</sup>P. 42.

laying hold of the plug and the direction of the pull were concerned, both requiring very radical changes from the monkey's own previous efforts."<sup>77</sup> He also says, "It seems to me that the two cases with the box are quite as good examples of imitation as could well be gotten even with human beings."<sup>78</sup>

Watson's contribution to this subject is the latest and agrees with Thorndike's in giving negative results. He reports three imitation tests made upon two *Macacus rhesus* monkeys. In no one of these tests did the watching animal learn to get food by seeing another animal get it. He concludes, "I unhesitatingly affirm that there was never the slightest evidence of inferential imitation manifested in the actions of any of these animals."<sup>79</sup>

If we group the work of the three investigators together, we have ten imitation tests in which four animals were used. One animal manifested imitative behavior in two different tests. None of the other three animals showed any tendency to imitate. From such fragmentary and conflicting evidence it is impossible to conclude what rôle imitation plays in the behavior of monkeys and the need for further investigation is apparent.

4. *Acknowledgments.*—In presenting this report of my investigation, I gratefully acknowledge my indebtedness to the Harvard Psychological Laboratory and, in particular, to Professor Robert M. Yerkes, at whose suggestion I undertook the investigation. His sympathetic coöperation at every stage of it has been invaluable. To Dr. William T. Hornaday, Director of the New York Zoölogical Park, I am deeply indebted for the opportunity to use the facilities of that great institution. His interest and generosity did much to further my work. The photographs which are here reproduced were made for me by Mr. E. R. Sanborn, the Staff Photographer of the Park. I am grateful for his services.

## II. DESCRIPTION AND CARE OF ANIMALS STUDIED.

### 1. *Cebus Monkeys.*

(a) *General Characteristics.*—In my experiments I have used

\*P. 144.

\*P. 122.

\*P. 172.

eleven animals from two genera and seven species. Eight of them represent five species of *Cebus* monkeys. This is the genus with which we are familiar as the consort of organ grinders. The home of these monkeys is South America, especially the head waters of the Amazon and northward into Central America, where they live a gregarious life in the tree tops, feeding on fruit, nuts and insects.

TABLE 1.  
NUMBER, SPECIES, SEX AND PROBABLE AGE OF ANIMALS USED IN THE INVESTIGATION.

No.	Species.	Sex.	Age.	Remarks.
No. 1.....	<i>Cebus lunatus</i>	Female	3 years	Bought of dealer in New York.
No. 2.....	" "	Male	3 "	Bought of dealer in New York.
No. 3.....	" <i>hypoleucus</i>	"	2 "	Bought of dealer in New York.
No. 4.....	" <i>fatuellus</i>	Female	6 "	Had been several years in Park.
No. 5.....	" <i>capucinus</i>	"	5 "	Had been several years in Park.
No. 6.....	" <i>lunatus</i>	Male	4 "	Had been several years in Park.
No. 8.....	" <i>hypoleucus</i>	"	7 "	In Park but eight weeks.
No. 9.....	" <i>flavus</i>	"	1 year	In Park but eight weeks.
No. 10.....	<i>Macacus rhesus</i>	Female	4 years	In Park two years.
No. 11.....	" "	Male	3 "	In Park two years.
No. 13.....	" <i>cynomolgus</i>	"	4 "	In Park two years.

They travel about by leaping from one tree to another; in this arboreal life their long grasping tails serve them better than a fifth hand would. The facial portion of the skull is small in comparison with the cranial portion, and many specimens have quite prominent foreheads. Forbes notes that the cerebral cortex is almost as much convoluted as it is in the Old World Apes. The forehead, usually bare of hair, is often wrinkled, giving the monkeys the appearance of being "burdened with sorrows, which," as Dr. Hornaday remarks, "most captive monkeys certainly are!"

The *Cebus* monkeys are cowards except toward those they can easily vanquish. One fight is usually enough to settle the supremacy of a cage. The whipped animal seldom makes another effort

to rule. The victor, however, often delights in continuing punishment which the vanquished receives with howls and shrieks of fear. The noise made by the victim is out of all proportion to the injury inflicted. A slap, a theft of banana, or even a threat often arouses piercing shrieks.

No. 6 and No. 4 were together one day in a small cage. It was about feeding time and both wanted to be at the wire front. No. 6 was in the way of No. 4 and she slapped him with the palm of her hand. He retreated and doubled up in his characteristic fashion, moving his body up and down and yelling loudly. Any movement of No. 4, even so much as the turn of her head toward him, served to release another volume of shrieks. This continued for several minutes with no further demonstration on the part of No. 4.

On another day, No. 4 was sitting on a brace in the experiment cage with her hands on the wire. Without allowing her to see me move, I touched my finger to the back of her index finger. As if struck by an electric current she leaped to the floor and began to yell vehemently and continued to do so for some time.

I am informed by Dr. Hornaday that the Cebus monkeys which are marketed in this country are obtained when quite young. The offspring rides about on the mother's back and hunters shoot the mother, who falls to the ground with the young still clinging to her. The small animal is then caught and kept in captivity until the keeper desires to ship it to market. This makes it next to impossible for any one who buys these monkeys of dealers to know much about their previous experience.

In a study such as this, however, it is desirable to know all that can be known of each animal's normal activities, so at the risk of multiplying words, I shall give a brief account of each animal used.

(b) *Characteristics of Individual Animals.*—No. 1, Cebus lunatus, female, and No. 2, Cebus lunatus, male, were obtained from an animal dealer in New York City. When they came to the Harvard Psychological Laboratory in November, 1907, they were apparently about three years old and were in excellent physical condition.

No. 1 made herself at home from the start and on the third day

would sit on my knee and eat her banana out of my hand. Within a short time she would ride on my shoulder as I walked about the laboratory, thus being sure to keep near whatever food I might have in my hand. No. 2, however, was more cautious, never coming near except when No. 1 preceded him, and retreating whenever he got his food. His favorite position was sitting on the floor of the cage with No. 1 sitting in front, and his arms clasped tightly around her body. When No. 1 moved, No. 2 would start nervously and try to keep close to her, never once taking his sparkling brown eyes off the persons in the room. Gradually his fear wore off and with No. 1 he went curiously about the cage, biting at every projecting piece of wood, and poking his fingers into every crack and cranny. A small tree was put into the cage and then the animals could stretch their tails by wrapping the tip end around a branch and suspending their whole weight from the limbs, a performance apparently as enjoyable to the monkeys as swimming is for the average boy.

The animals did not like to be separated. No. 2 was especially concerned when No. 1 came out of the cage to get food and he was left alone. Often, when alone, he would utter a shrill piercing sound, a veritable bark. This was unlike their usual noises of chattering, whistling and crying and I took it to be a danger signal, for No. 1 never failed to climb the cage, window or anything else near her when the cry was given. Even when, after a day's fast, she was greedily eating her banana, it would be left with a startling suddenness and she would make no delay until she was at the highest point in the room. She never looked about to discover the danger for herself and never ran on the floor. Her action was always one impetuous scramble to get *up*. She never remained up long and often came down immediately. I never heard her utter the cry. He sometimes gave it when she was out of sight, but again when she was in plain view, and when there was no disturbance in the room. In the wild state, such a cry is probably the signal that some enemy is near, and when given, all that hear it scud to the tree tops as the place of greatest safety.

After a few weeks in the laboratory, No. 1 acquired a pugnacious

attitude toward certain persons, usually strangers. I first noticed it one day when an expressman called to leave a package. He entered without noticing her and when he turned to leave she was on a cage which he must pass in going to the door. Her mouth was open, her teeth exposed, and her body drawn into a crouching attitude as if she were about to spring. I intervened, while the man left, for fear she might bite or scratch him. A day or two later she behaved in the same way toward the laboratory machinist, who came in to do some work. As he went toward the door, her fury increased like that of a dog after a retreating enemy. I began to suspect there was more of bluff than fight in her behavior and my suspicions were fully justified a few days later. Experiments were over for the day and No. 1 was having her freedom about the room to the delight of the several persons present. A stranger entered the room. She was at the opposite end and on top of a six-foot cage when he entered. She immediately prepared for war and her scolding and threatening began. She advanced toward him along the top of the cage by short leaps, which grew shorter as she neared him. Her scolding increased, her hair became erect and her wide-open mouth showed her keen teeth as if she were ready to bite. Suddenly she leaped from the cage toward him (most men would have dodged or struck, but this man did neither) and she landed plump upon his chest. Instantly her harsh cries became more like the purr of a cat, and her hand found its way to his jewelled tie pin and on up to his moustache. She was not angry.

No. 2 never assumed the bluffing attitude. He showed, however, more ingenuity in learning to do things. During his whole life in Cambridge and also in New York he refused to be petted, and when caught was in great fright. This fear often distracted his attention from working at problems. He worked by spurts, glancing at persons in the room and then making a vigorous thrust or pull at the mechanism. It was only by maintaining the most rigid quiet in a room that I could induce No. 2 to give continuous attention to a problem. Despite this fact, however, he learned to get food in devious ways much more quickly than No. 1, whose familiarity with human beings had possibly led her to depend on them for her food.



No. 1 died suddenly, from no obvious cause, at the close of the first experiment. No. 2 was taken to New York in June, 1908. He remained in good health throughout the entire investigation.

No. 3, *Cebus hypoleucus*, male, was a small animal apparently less than two years of age. He was shipped with a mate from New York City to the Harvard Laboratory in March, 1908. He had not long been off the ship which brought him to New York and was in poor physical condition. He never became vigorous, but his good appetite kept him hunting for food. He was one of the animals taken to the Park in June and was used in a number of tests.

No. 4, *Cebus fatuellus*, female, was a large fine animal. She was full grown, probably six years of age and had been in the Zoölogical Park half of that time. She was kept, with Nos. 5, 6, 8, and 9, in a large cage which contained a number of *Cebus* and Spider monkeys and several lemurs. She was the boss of the cage, and was very aggressive toward the other animals, especially when food was put into the cage. She was physically the strongest *Cebus* monkey I have studied, but when she did not readily solve a mechanism she gave up trying sooner than did No. 5. She was always attentive to any movements of the experimenter or of another monkey in the cage. She was not afraid, but would not allow herself to be handled.

No. 5, *Cebus capucinus*, female, was the most active animal I used. She was scarcely ever quiet in the experiment cage except when she crouched in fear. She was almost as strong as No. 4 but had less inclination to fight and to take food from other animals. However, no animal in the large cage excepting No. 4 dared to take food from her. When any new device was exposed in the experiment cage, No. 5 examined every part of it with great rapidity and her interest did not abate if she did not solve the problem at once. She returned repeatedly to every new part in the cage and worked at it persistently, using all her ingenuity and strength to get food or to tear the mechanism to pieces. She was five years of age and had been several years in the Park.

No. 6, *Cebus lunatus*, male, was thoroughly at home with per-

sons. He was very playful and enjoyed being handled. He was as free with strangers as with familiar persons and would pull and play with sticks, pencils, umbrellas or any other thing that any one held out to him. If a person got sufficiently near his cage, he would dig into his pockets for handkerchiefs. As a rule he was not attentive to the other animals; he preferred to attract human attention. For this reason it was difficult to get him to watch the other animal in the imitation tests. He stood third in supremacy in the large cage, yielding only to No. 4 and No. 5. He was four years old and had been in the Park two years.

No. 8, *Cebus hypoleucus*, male, was a new arrival at the Park. He was old, apparently seven or eight years of age, and one canine was missing; the other teeth were very large. He was large and lank, with long bony arms and legs. He moved slowly and when in a new situation was quiet and sluggish. He was used in one imitation experiment only and failed in that. He was apparently afraid most of the time and was whipped by animals much smaller than himself.

No. 9, *Cebus flavus*, male, was the smallest animal used in the investigation. He was probably but little over a year old and had been in the Park but six weeks, having come in with No. 8 and six others. He was very much of a baby, riding on the back of his cage mate most of the time. He was quite excitable and cried a great deal when alone. When with No. 8 he was a perfect parasite, stealing food and riding. Toward No. 3, he developed a fighting attitude and under the protection of No. 6 almost worried No. 3 to death during one night. He did not want to be touched by persons, but his fear did not keep him from getting food within his reach.

## 2. *Macacus Monkeys.*

(a) *General Characteristics.*—The *Macacus* is the most common form of the Eastern monkey. The group contains twenty-five species, many of which are found in captivity and are among the most hardy of captive monkeys. The most common form is the *Macacus cynomolgus* which is found in various parts of Asia and in the East Indian Islands. The tail of this species is quite long and is one

of its distinguishing marks. These animals are large, strong, and apparently courageous. Both the cynomolgus and rhesus monkeys have cheek pouches in which they store food. Both make a show of courage and, in comparison with the *Cebus* monkeys, are quite courageous.

(b) *Characteristics of Individual Animals.*—No. 10, *Macacus rhesus*, female, was four years old and had been in the Park more than a year, during which time she had been caged with a large female common macaque. Both of these animals had an apparent dislike for strangers and would dash at the side of the cage when any one approached. No. 10 was in the laboratory only three weeks, in a cage with No. 11, a male of her own species. She was much afraid of me at first and rushed about the cage to get away. She soon became quiet and for ten days was an exceptionally good animal for study. She was active, quick and hungry. Before the tests with her were over, she was attacked with dysentery and became useless for experimentation.

No. 11, *Macacus rhesus*, male, was a young animal about three years old but very large. He had a long well-rounded body, well-shaped limbs, and well-developed quarters. During the time he was in the laboratory he was in superb physical condition. He was quick, active and strong. He seemed never to be off his guard. His muscles were always tense and he leaped suddenly and with great force. He was not afraid, but would not allow himself to be handled. No. 10 whipped him, but he showed fight toward all the other animals and never retreated.

No. 13, *Macacus cynomolgus*, male, was a large vigorous animal about four years old, who was not afraid of persons or other animals, yet who was not of a pugnacious disposition. He whipped No. 12, his cage mate, while they were in the laboratory, but after he had settled the supremacy of the cage he lived peaceably with him. Like No. 11, he was always attentive to other animals and seldom failed to see anything he could turn to his own advantage. He was quick and strong, and during the experiments, was in fine physical condition.

3. *Care of Animals.*

During the progress of the experiments the animals were kept in the laboratory all the time. They were grouped one, two, and three in small cages, the aim being to secure for each, congenial cage-mates,—not an easy thing to do with the full-grown animals. The cages were cared for and food was given daily by the keeper. The Park Veterinarian, Dr. Blair, stopped occasionally to see that the animals were in good health. No other persons had access to the laboratory, except the experimenter and persons whom he invited to be present at experiments.

The animals were then kept in a normal condition, undisturbed by the crowds of visitors which thronged the Primates' House during the summer. Effort was made to eliminate fear. The experiment cage was large and light and the animals were fed in it so often that they were glad to get into it. No effort was made to handle the monkeys with the hands in transferring them from one cage to another. They were allowed to go down a runway, or to enter a small box which was then transferred to the larger one and the animal was released. Food was given along all parts of this runway and in the cage, and the animals were usually in their normal state when in the experiment cage.

The daily food was given at 2:30 P. M. Enough was given to keep the animals in good condition but not enough to satiate them. The weekly menu, given under the experimenter's direction, was as follows:

*Sunday.* Bananas, yellow corn, sunflower seed.

*Monday.* Boiled potatoes, bread, bananas.

*Tuesday.* Roasted peanuts, bread, apples.

*Wednesday.* Cabbage, lettuce, carrots, bread, bananas.

*Thursday.* Boiled potatoes, bread, apples.

*Friday.* Boiled rice with raisins, bananas.

*Saturday.* Boiled potatoes, bread, dates.

## III. METHOD OF INVESTIGATION.

1. *Problem Method Used.*—I have used in the investigation the problem method only. The animals have been placed in the pres-

ence of simple mechanical devices, the manipulation of which opened doors, disclosed openings, or dropped food into the experiment cage. The motives to action on the part of the monkeys were three: curiosity, the obtaining of food, and the tendency to imitate.

The problems which I have used are all comparatively simple. It is an easy matter to construct devices which monkeys will not manipulate, either on their own initiative or by imitation. The results from such problems, however, have only a negative value in the study of animal intelligence. To demand that an animal perform a wholly new act, that he behave in a way entirely different from his usual ways of acting, is a legitimate mode of procedure for certain purposes. But if a monkey fails to manifest imitative behavior under complex and excessively strange conditions, it is not proof that the animal lacks imitative ability.

Human beings do not imitate all the acts of their fellows, not even all those which it would be profitable to copy, and to judge by such failures would be to class man as a non-imitative animal. This would be manifestly unfair, for in certain other situations the imitative behavior will appear. The fact is that we imitate most often in those situations in which wholly new elements are few. We are reinforced by a great complex of habitual reactions, and, when the new elements are mastered by imitation, these habitual modes of activity complete the learning in a more or less automatic way. Because we take advantage of our fund of habits is, however, no reason to deny that our real advances in learning may be by imitation. We do not demand that a person perform an act wholly and entirely new before we credit him with imitative learning.

We certainly should not be less generous with other animals. They should be met as nearly as possible on their own ground and presented with problems in which they may have the advantage of their fund of inherited and acquired modes of behavior. At first the elements entirely new should be as few as possible. If they are then unable to profit by seeing another animal perform an act the case against their ability to learn by imitation would seem to be conclusive. If under such simple conditions they do

manifest imitative behavior, the complexity of the problems can be increased and thus by successive steps the range of imitative ability can be determined.

Viewing the matter in this way, I deemed it important to give the monkeys an extended preliminary study. I was unable for some time to set problems which seemed well suited to the purpose, and my best ideas seemed to come accidentally as I was observing the animals. From a large number of possible problems, selection and combination was made so that, in the end, I had a group of devices presenting situations adapted to the monkey's ways of doing things. The value of this preliminary work, I am sure, is evident in the results of the experiments.

2. *Laboratories and Apparatus.* (a) *Laboratories.* The experiments made in Cambridge were conducted in a research room of the Harvard Laboratory. The living cages were located against the wall of the large airy room. Between these living cages and the experiment cages, a curtain was drawn while the experiments were in progress. Light fell upon the experiment cages from two large windows so that all parts of the apparatus were well illuminated. The room was on a third floor and on the side away from the street. It was, therefore, exceptionally free from the noises and jars of traffic.

At the Park, a laboratory was arranged in a room at one end of the Primates' House. The room was 15 feet long and 12 feet wide, with good light from two sides and the roof. Along the two sides of the room opposite the windows, were the living cages, where the animals were kept, two and three in a cage. Between these cages and the windows a floor space, 7 by 10 feet, gave sufficient room for the experiment cage described below. Its wire sides were toward the windows so that it might be well lighted. The experiment cage was separated from the living cages by curtains which could be drawn back when the experiments were over.

(b) *Experiment cages.* In presenting problems to monkeys one meets two difficulties at once. If the animals are left free in a room they wander about, examine everything in the room and give only intermittent attention to the problem, thus wasting time.

On the other hand, if the problems are adjusted in a small box, the animal is cramped and often frightened. In order to minimize these difficulties I built an experiment cage (fig. 1) which was 182 cm. high, 124 cm. broad and 92 cm. deep. It was large enough to allow considerable freedom to the animal and yet not so large but that the monkey was kept near the problem all the time. The top, the floor, the back and one end of the cage were made of rough pine boards. In these board parts of the cage were adjusted several mechanisms. The problem for the monkey was to manipulate one or another mechanical device. The front of the cage and one end were covered with half-inch mesh wire which made possible a view of the entire interior. At the bottom of the front was a slide door through which the animals were introduced into the cage.

This cage was used in all the preliminary experiments and for the first complete set of imitation tests. In the light of knowledge gained in its use, a new and improved cage was built. Hereafter, these two cages will be designated as the old cage and the new cage respectively.

The new cage (fig. 2) was used in all the experiments made at the Park. It was made of clear white pine lumber, was built in sections and put together with bolts. The frame was in four parts, of material  $4\frac{1}{2}$  cm. square. The front frame, *a, b, c, d*, and the back frame, *e, f, g, h*, were each 118 cm. by 180 cm. The end frames, *i, g, k, l*, and *m, n, o, p*, were each 85 cm. by 180 cm. When these four parts were bolted together they made a cubical frame 85 cm. by 118 cm. by 180 cm. Across the front, half way up was a brace, *q*, of the frame material. The end of the brace, *X*, was a favorite place for the animals to perch. The front and one end of the frame were covered with galvanized woven wire of one inch mesh. The back of the cage was covered with four boards, *A, B, C*, and *D*, 29 cm. wide and 2 cm. thick, placed vertically and fastened to the top and bottom of the frame by bolts with wing nuts, *W*. The remaining end of the frame was similarly covered by three boards, one of which, *E*, was fastened as those on the back, and two of which, *F* and *G*, were made into a door hinged at *h*.<sup>1</sup> The top of the cage consisted of three boards *H, I*, and *J*, 29

cm. by 85 cm. which were fastened to the frame in the same way as were the boards of the back. The floor, in one piece, *Z*, rested on the frame at the bottom of the cage and could be taken out for cleaning. In the lower part of board *F* was a slide door, *S*, 24 cm. by 32 cm. whose lower edge was on a level with the floor. The cage was mounted on ball-bearing castors so that it could be moved about easily and quietly.

The boards on the back, end, and top of the cage were half-tongued so that no cracks appeared between them. They were removable and other boards of corresponding dimensions could be substituted. The mechanical devices which were presented to the animals as problems for manipulation were arranged in separate boards. The cage was made ready for experimentation by removing one of the plain boards and substituting a board with a device. This convenience made it possible to shift from one experiment to another with facility.

(c) *Problems.*—In the two cages eight problems were arranged. These I shall describe in connection with the statements of results. Here it will be sufficient to designate them by name, as follows:

1. Chute Experiment A. In old cage.
2. Chute Experiment B. In new cage.
3. Rope Experiment. In new cage.
4. Paper Experiment. In new cage.
5. Screen Experiment. In new cage.
6. Plug Experiment. In new cage.
7. Button Experiment. In new cage.
8. String Experiment. In new cage.

3. *Experimental Procedure.*—For the most part, the experiments were made between 7:00 A. M. and 1:00 P. M. when the animals were in a normal state of hunger and when they were fresh from the night's sleep. During some of the later experiments it was necessary to continue the work until later in the afternoon. In such cases, the feeding time was postponed for the animals so used. The first experiment was made on successive afternoons between two and three o'clock.

The general plan of the experiments was as follows: First, each animal was given a fair opportunity to learn to manipu-



late the mechanism in a series of preliminary trials. These trials were usually on successive days, rarely twice in one day. In all experiments, except the Chute Experiment A, which was made in the old cage in Cambridge, the animal was given *five of these preliminary trials, each fifteen minutes in length.* In almost every case the animal had either solved the problem or had become indifferent to the mechanism by the end of this time.

At the close of these preliminary trials, imitation tests were begun with the animals that had failed to learn of their own accord. In these tests, the trained animal was allowed to perform in the presence of the imitator; after this, the latter was given an opportunity to get the food himself. He was permitted to work *ten minutes*, and longer, if he seemed about to solve the problem. If imitation did not occur in the first test, the test was repeated. An animal was not counted to have failed until he had seen the performance a hundred times, and yet was not able to repeat it.

Wherever the experiments varied from this schedule the fact is stated in the account of the experiments.

In some of the tests, the two animals were together in the cage; in other tests the imitator was confined in an observation-box within the experiment cage while the imitatee got food by manipulating the device. This observation-box was approximately 40, by 60, by 80 cm. and was covered on five sides with woven wire of half-inch mesh.

4. *Observation and Description of Behavior.*—My first aim in this investigation has been *to record the facts of behavior.* Just what names to apply to the types of behavior manifested has been a secondary consideration. The question of imitation in animals bears, at present, a somewhat controversial aspect and I have felt that I could best contribute to a clearing away of difficulties by making a full and accurate record of exactly what I saw my animals do under experimental conditions. This I have faithfully tried to do, with the result that I have a paper full of details. However, I am convinced that this is really the way of progress in this matter. Mere forensic insistence on a certain point of view regarding the problem of imitation in animals, may, in the absence of the real

facts of behavior, be a pleasant pastime, but it can add nothing to a solution of our problem.

In describing the behavior of the animals and in interpreting that behavior, it has been my aim to use all terms in as objective a way as possible. Certain words with a subjective implication are, however, so indispensable for convenience that I have ventured to use them, and to define them objectively to avoid misunderstanding.

The verb *see* was needed so often that to have found a roundabout substitute with a wholly objective signification, would have needlessly encumbered the account with words. When an animal's eyes were directed toward a thing, when he turned his head or fixed his gaze apparently in response to the movement of another animal, when he reacted toward an object by going toward it or away from it, I have chosen to say that the animal "*saw*" the thing to which he apparently responded. In case there was an accentuation of such behavior, an apparent increase of muscle tension and eagerness to make such movements, I have said the animal "*saw well*" or "*saw perfectly*." I have said he saw "*fairly well*," if the objective marks of attention were present, but not normally strong. In none of these cases, however, do I intend to imply more than that the animal manifested such behavior.

So, also with the word *experience*. When an animal ate the food which was obtained by the manipulation of a device I have said *he experienced the result* of the act, but throughout the presentation of data and the interpretation thereof, I have meant nothing more than that he ate the food so obtained. I have intended to imply nothing as to the psychic aspect of such behavior.

The same is true of my use of the word *imitation* which I shall define in the general summary of Chute Experiments A and B, page 376.

It has been convenient to use a few common terms with technical meaning. To denote the several times an animal was in the cage alone before he was given an opportunity to learn by imitation, I have used the word *trial*. I have used the word *test* to mean the opportunity an animal had to learn from another animal. The word

covers both the time the imitatee was performing and the time the imitator remained in the cage after the removal of the imitatee. To indicate the act of the imitatee in getting food, I have used the word *performance*. Successive performances are indicated by P. 2, P. 3, etc.

#### IV. EXPERIMENTS AND RESULTS.

##### 1. CHUTE EXPERIMENT A.

###### *A. Description of Device.*

In the top of the old cage (fig. 1), near the wire front and the wire end was a door, *a*, 10 cm. square, which opened inward and was held shut by a device, *b*, on the top of the cage. At a point in the top near the board end and the back, a hollow chute, *c*, 5 cm. square, projected perpendicularly into the cage 60 cm. From the device which held the door shut, a string, *d*, passed to the top of the chute and hung down on the inside to within 10 cm. of the bottom of it. To the end of the string was fastened a bit of iron, *e*, to serve as a hand hold. The top of the chute was covered with a cap, *f*, so that no light could come through it.

In order to secure the food, the monkey must leap from the wire part of the cage to the chute, and, while holding to it, must thrust a hand up inside and pull the string, thereby releasing the small door in the top of the cage and allowing food which had been placed on it to fall to the floor. He must then descend to the floor to get the food.

###### *B. Behavior of No. 2.*

*Preliminary trials.*—First trial, Jan. 4. No. 2 first picked up crumbs of food from the floor of the cage. He then played about on the floor and the wire end and front of the cage. He jumped from the front of the cage to the chute and back to the front. This he repeated five times. He took no notice of the end of the chute. Time: 30 minutes.

Second trial, Jan. 6. The behavior of No. 2 was similar to what it was on Jan. 4. He seemed quite anxious to escape. He jumped to the chute three times. The third jump so shook the chute that the door was jarred open and the food (peanuts) fell to the floor. No. 2 noticed the food immediately and climbed down to eat it. When the nuts had been eaten, he climbed the front of the cage, and, holding with his feet to the wire, reached the swinging door with his hands and thrust his head up through the open door.

Third trial, Jan. 7. No. 2 was quite shy. He ate crumbs from the floor and climbed the wire parts of the cage. During the thirty minutes he jumped to the chute twenty-two times.

Fourth trial, Jan. 8. No. 2 jumped to the chute repeatedly and on the seventh jump he threw his head and shoulders downwards. While hanging by his tail and feet, he looked up the chute, thrust up his hand and pulled the string. The food fell. Twenty times more he jumped to the chute, but did not get food.

On Jan. 9, Jan. 13, Jan. 20, he was tried again and on the latter date he opened the trap door ten times in twenty-seven minutes. He was then counted to have learned sufficiently to set the copy for No. 1.

#### *C. Behavior of No. 1.*

*Preliminary trials.*—No. 1 was first put into the experiment box on Jan. 7. She was quite hungry and scolded and chattered all the time. She picked crumbs from the floor and climbed the wire on the front and the end of the cage. During the thirty minutes she was in the cage she took no notice of the chute.

On thirteen succeeding days for the same length of time she repeated this behavior. On Jan. 21, her jumping about the cage jostled open the trap door. This called attention to the door and several times later she climbed the front of the cage and reached one hand over to the edge of the door. There was, however, no evidence that the chute and door were connected by the animal.

*Imitation tests. No. 1 imitating No. 2.*—First test. At this time, it seemed evident that No. 1 would not of her own accord learn to work the device. For the imitation test she was placed within a wire-covered box, inside and at the end of the experiment cage opposite the chute. No. 2 was then placed in the cage and allowed to open the food door. The small box served as a place from which No. 2 could jump to the chute and thus modified the conditions of the experiment. The box was removed and the two animals were placed in the large cage together. Prof. Yerkes was present and we were agreed that out of the seven times which No. 2 opened the door, No. 1 saw the entire performance twice, and in part, at least, four other times. No. 2 was removed from the cage and No. 1 was left alone for thirty minutes. The following observations are quoted from Prof. Yerkes' notes: "After a few minutes of climbing about, No. 1 looked up at the chute from the floor, stood on her feet, lifted her body and face upward, climbed the side of the cage as if she were making right for the chute, but she did not jump across to it. I am not certain that she looked across at the chute from the side of the cage. During the remainder of the interval I saw no evidences of the influences of what she had seen."

Second test. No. 2 was again placed in the cage and allowed to operate the mechanism. Each time No. 1 got food; sometimes she took all of it. Twice again she saw the entire performance and four times more she saw it in part. No. 2 was then removed and No. 1 was left in the cage for thirty minutes. There were no indications that the behavior of No. 2 had in any way influenced the behavior of No. 1.

The test was repeated on sixteen different days. No. 2 operated the device a total of 253 times. No. 1 saw 204 of these. On no day did she see the entire performance fewer than three times nor oftener than twenty times (see Table 2).

On each day, after being given the opportunity to witness the behavior of No. 2, No. 1 was left in the cage alone for thirty minutes. On Feb. 6, after being alone for a few minutes, No. 1 stood under the chute and looked up at

it. She then ran to the side of the cage as if to climb, but her attention was distracted and she did not climb. Later she climbed the front of the cage and clinging with her feet and one hand, she allowed her body, head and other arm to swing away from the cage toward the chute. This conduct came nearest to suggesting the influence of No. 2's behavior of any during the whole of the experiment.

In all the later tests, No. 1 was more or less attentive to No. 2 and usually got food when he pulled the string, but when he was removed she became quite indifferent to the chute and took her leisure about the cage as if the means of getting food was not present.

TABLE 2.  
No. 1 IMITATING No. 2.

Date—1908.	Number of times No. 2 performed the act.	Number of times No. 1 saw No. 2.	Number of times No. 1 saw in part.	Result.	Time in Minutes.
Jan. 30a . . . .	7	3	3	Failed.	30
Jan. 30b . . . .	6	3	3	F	30
Jan. 31 . . . . .	11	8	3	F	30
Feb. 4 . . . . .	17	10	7	F	30
Feb. 6 . . . . .	10	10		F	30
Feb. 10 . . . . .	12	10	2	F	30
Feb. 17 . . . . .	12	10	2	F	30
Feb. 18 . . . . .	13	10	1	F	30
Feb. 19 . . . . .	10	10		F	30
Feb. 20 . . . . .	12	10	2	F	30
Feb. 24 . . . . .	10	10		F	30
Feb. 25 . . . . .	12	10	2	F	30
Feb. 26 . . . . .	22	20		F	30
Feb. 27 . . . . .	20	20	1	F	30
Feb. 28 . . . . .	23	20	3	F	30
Feb. 29 . . . . .	33	20	3	F	30
March 2 . . . . .	23	20	3	F	30
Total . . . . .	253	204	35	F	510

*S* means that the imitator did repeat the behavior of the imitatee.

*F* means that the imitator failed to repeat the behavior of the imitatee.

The time is always given in minutes unless otherwise indicated. It was taken with an ordinary watch and where it is recorded in seconds the time was taken from the second hand.

*How No. 1 Learned.*—March 3. No. 1 had been given more than two hundred opportunities to see No. 2 perform the operation and had profited frequently by getting food. It then seemed certain that she would not learn to work the device from seeing No. 2 do it. A stick, two inches wide, was placed from the wire front of the cage to the chute. Within eight minutes, No. 1 had climbed the side of the cage, had walked on the stick to the chute, had swung down and thrusting her hand up the chute had opened the door. The stick was then removed while No. 1 was on the floor. When her food was eaten she became very active, making long leaps all about

the cage, but never once to the chute. She then settled down to her usual behavior and after ten minutes the stick was replaced. She pulled the string once and the stick was again removed. She then resumed her usual conduct for almost ten minutes more. Then, when under the chute, she looked up and her eyes accidentally fell on the chute. She rushed up the front of the cage and leaped to the chute, swung herself down and worked the device. This she repeated several times, although in a much less skillful way than No. 2 was able to do it.

## 2. CHUTE EXPERIMENT B.

### *A. Description of Device.*

This apparatus was a modification of the one used in Chute Experiment A.

From the top of the experiment cage (fig. 3), 30 cm. from the board side and 40 cm. from the board end, a hollow wooden chute, *a*, 5 cm. square, projected into the cage a distance of 70 cm. Inside this chute, 40 cm. from the lower end was a trap door, *b*, hinged to drop downward, but held up by a rubber elastic. To the bottom of this trap door was attached a string, *c*, which hung down to within 10 cm. of the lower edge of the chute. A coiled wire spring, *d*, was tied to the lower end of the string to serve for a hand-hold for the animals. In the top of the cage was a tube leading into the chute from a small feeder (fig. 19, *f*.) adjusted on top of the cage. By pulling a string, attached to the feeder, the experimenter could drop food (sunflower seed and chopped peanuts) upon the trap door.\* Two horizontal rungs nailed to the sides of the chute helped the animal to support himself on the chute.

The problem set for the animal was to leap from the wire front or end of the cage and, while holding to the chute, to swing his head and shoulders down, thrust one hand up the inside of the chute, grasp the coiled spring, and pull the trap door down. The food on the top of the door would then fall to the floor, unless checked by striking the body of the animal. In either case the animal could get it.

### *B. Behavior of No. 2.*

No. 2 had learned to work the mechanism in Chute Experiment A. But when he was first put into the new cage, four months after his last experience in the old one, he apparently had no memory of the chute. Only after several minutes did he go to it. He jumped to it from the front wire. He stopped to examine the opening in the end before he thrust his hand into it. In the old cage he usually thrust his hand into the opening without

\*The essential part of the feeder was a copper plate, 3 cm. wide and 6 mm. thick, arranged to slide back and forth in grooves beneath a food hopper. In the plate was a circular opening into which the food dropped from the hopper. When the string was pulled this opening, full of food, was drawn over a tube leading into the chute, into which the food dropped.

looking at it. After examination, he pushed his hand up the inside and touched the string. Then he became very eager to work and would have worked continually (fig. 4).

*C. Behavior of No. 13.*

*Preliminary trials.*—First trial, August 23. On entering the cage, No. 13 climbed to *X* where he sat for a short time. He then walked along the brace until opposite the chute, when he leaned out toward the chute and touched it with his hands, a little way above the lower edge. Drawing his body back from the chute, he walked along to *X* and went down to the floor. Several times he climbed up and down the wire parts of the cage and then tried to get out at the door. He went back and forth from the door to *X*. In his endeavor to get out of the cage, he pushed on the small doors repeatedly and even climbed the wire front to push on the upper part of the large door. Next he settled at *X* and looked about. He moved down to the floor and up and down the wire. Moving along the brace to the door, he tried to push it open. He then descended to the floor. He tried to climb the corner post opposite *X* and then climbed the wire to the top of the front, going to the floor again and then up to *X*. He was active during the entire time he was in the cage, but he took no notice of the chute after the first three minutes.

Second trial, August 24. The movements of No. 13 on this day were as follows: Up the end of the cage; to the floor; up to the brace and along the brace to opposite the chute; leaned over to the chute and put hands on the lower rung; felt up and down the edges of the chute nearest him; tried to bite the edges of the chute; back to the wire and to the floor; again up to the brace and leaned over to the chute; again bit the edges of the chute; to the floor, about, and looked up at the chute from exactly under it; to the door; up to *X* and perched; to the floor and hunted about; bit the door; again to *X* and perched, looking out through the wire; down to the floor to get a roach and back to the brace; up the wire front, and back to *X*; to the door and back to *X*; along the brace; putting his hands over on the chute, he swung his body to the chute and climbed up on it to the top of the cage and looked at the screws, etc.; tried to bite rung; back to brace and perched at *X*.

Third trial, August 26. Behavior as follows: Climbed wire; perched at *X*; to the floor; to the door; up front and around to the top of the wire end; back to *X* where he sat for a little time; to the floor and hunted all about; to the place where *L\** had been and hunted for it; back to *X* and along the brace to the large door; turned around, faced the chute, but paid no attention to it; to the floor, all about and back up to *X*; along the brace to the chute; leaned over to it; put hands on the near edges and looked up and down; grasped rung in one hand and pushed other up and down the edges of the chute; back to *X*; to the chute and clung to it while he examined the top of

\*An opening where he had gotten food in a previous experiment.

the cage; on the chute two minutes and then slid down to the end and dropped off; again to the chute and examined the crack in the top of the cage; perched on the rung and looked out of the cage; bit at the edges and then jumped off.

Fourth trial, August 27. Behavior as follows: To *X* and sat down; along the brace and back to *X* and to the floor; up the front and along the brace to *X* and up the end of the cage; to the floor and about all the edges looking for food; up to *X*, along the brace, and to the floor; about the floor and to the door, which he tried to open; to the end of the cage; up, around to the front and sat at *X*; up the end of the cage and down to the floor; to the corner opposite *X*; to the front, up and sat at *X*; up and down the wire; up the front, around to the end and back to the front; to the end and down to the floor; up to *X* and sat; up the front of the cage and shook it.

Fifth trial, August 29. Behavior as follows: Up and down the end of the cage; to the door and up the front; to the chute and sat on the rungs; back to front and to *X* where he sat for some time; to the floor and to the door, which he tried persistently to open; climbed the front and looked about; to the floor and pushed on the door very hard; up the front and perched at *X*; up the end of the cage and back to *X*; along the brace and pushed at the chute; to *X* and down to the door; up the front and to the chute; back to the brace and along it to the end of the cage and back to *X*; to the floor and back to *X*; looked up at *X* from the floor; afterward climbed to *X* and sat there during the remaining part of the time.

*Imitation test.—No. 13 imitating No. 4.\** First test. No. 13 was put into the observation box and the box was set on the floor of the cage so that No. 13 could have a good view of the chute. No. 4 was put into the cage and, at once, began to get food from the chute. No. 13 was attentive to every movement. His record in seeing is as follows:

Performance 1. No. 13 saw perfectly and became very threatening and eager to get out of the cage.

P. 2. Just as No. 4 thrust her hand up the chute, No. 13 looked down. As a result he did not see the pull. He saw her eating food and shook his box with such force that he moved it about over the floor.

P. 3. No. 13 saw perfectly and sat on the floor of his box attentively watching No. 4 eat her food.

P. 4. No. 13 saw perfectly and was eager to get out.

P. 5. No. 13 saw fairly well; he was eager to get out of the box; failing to get free he sat on the floor of his box and watched No. 4 eat the food.

These performances did not occupy more than five minutes. No. 4 was now removed and No. 13 was released in the cage. At first he looked about over the floor for food and then climbed the front wire, stopping on the brace opposite the chute. He leaned over to the chute and while still standing on the brace with his feet, tried to thrust a hand into the bottom of the chute. Failing in this, he ran along the brace to *X* and back again to opposite the

\*The learning of No. 4 will be given later.



chute; catching the rung of the chute in his hands he drew himself over to it; finding himself above the end of the chute he tried to let his body down, first on one side and then on the other, until in the most awkward manner he managed to get near enough to the end to thrust a hand up the inside far enough to reach the string. At once he pulled and the food came tumbling down on his chest and to the floor. Dropping to the floor he picked up the food and ate it. The time from the removal of No. 4 was 40 seconds.

Within one minute he climbed the front wire, reached the chute, and got food in the same manner. On reaching the chute the third time he did not pull himself above the end, but holding to the rung with his hands he dropped his body below the end and placing his feet against the back of the cage steadied himself while he thrust the free hand up inside and pulled the string. Time: 40 seconds. From this time on No. 13 repeated the performance as rapidly as his food was eaten. Within ten minutes he had gotten food eleven times and had eaten it all. From the moment he was released in the cage he seemed bent on getting the food. In his efforts, he made but one useless movement, namely, when he drew back from the chute after first putting his hands on it. This, however, did not indicate a wavering from the end in view. It was merely a drawing back for the renewed effort which he immediately made.

*Summary of Behavior of No. 13 in Chute Experiment B.*

During the preliminary trials No. 13 was exceedingly active, but at the end of the time he had made no progress toward a solution of the problem. He had gone to the chute, but there was no evidence that this was more than a random act in his movements about the cage. He did not notice the end of the chute and in no way did he seem to connect the chute with getting food. During his last trial he was quiet much of the time.

After his preliminary trials he saw No. 4 getting food at the end of the chute five times. He was confined in an observation box so that he could not follow No. 4 about. He did not get any food and he experienced the result in no way. However, when he was released in the cage his behavior was strikingly different from his behavior during any of his preliminary trials. He went almost directly to the place where he had seen No. 4 get food and within two-thirds of a minute he had gotten food for himself by doing essentially the same act No. 4 had done while he was watching her.

TABLE 3.

NO. 13 IMITATING NO. 4.

Date	Number of times No. 4 performed the act.	Number of times No. 13 saw.	Number of times No. 13 saw in part.	Result.	Time in Seconds.
Aug. 29 . . . . .	5	4	1	S	40

*D. Behavior of No. 4.*

First trial. No. 4 spent her time on the floor and the sides of the cage. She was fairly active. After four minutes of random movements about the cage, she hung by her tail and two feet to the front of the cage opposite the chute and swung her body around crane-like toward the chute, looking at it steadily. She then moved about the cage as if she had nothing to do; she either sat quietly or leisurely climbed the cage.

Second trial. No. 4 walked about on the floor; then climbed the wire and looked about. Once or twice she examined the cracks in the floor and in the door. She looked at the chute twice and looked out through the wire toward the window.

Third trial. During the third period No. 4 spent her time on the floor and in climbing the wire. Several times she pulled on the brace across the front of the cage and then remained quiet. She paid no attention to the chute during the entire time she was in the cage.

Fourth trial. On the fourth day No. 4 spent most of her time perched on the brace. She varied this by climbing up and down, catching roaches, and looking out through the wire and the window. She displayed no interest in the chute during the entire time she was in the cage.

Fifth trial. On the fifth day No. 4 spent her entire time on the floor, on the brace, and in climbing the wire. Most of the time she sat still, and when disturbed, simply changed her position and settled down again.

No. 4 paid most attention to the chute on her first day's trial. On the second day she gave it less attention, and on the third, fourth and fifth days none whatever.

*Imitation tests.*—*No. 4 imitating No. 2.*—The animals were put into the cage together. At first No. 2 was afraid of No. 4, who walked about the floor and climbed the wire at her will. As No. 2 would not work at the chute because of his fear, No. 4 was put into the observation box and the box was placed on the floor of the cage. No. 2 was still afraid and refused to work for some time. After twenty minutes, he leaped to the chute and pulled the string. No. 4 did not see him, but some of the food fell into her box and she ate it. Fifteen minutes later No. 2 jumped to the chute, but he did not pull the string. No. 4 saw him on the chute. Later No. 2 jumped to the chute, pulled the string and caught a seed on his chest. No. 4 saw him on the chute, but did not see him pull the string. The next time No. 4 saw nothing, but got food. No. 2 then became more frightened at No. 4 and refused to jump to the chute during the rest of the morning. Since No. 4 had not seen the entire performance once, she was not given an opportunity to get the food.

Second trial. This trial was made on the afternoon of the same day as the previous test. No. 2 was still much frightened and worked very slowly. The first time he pulled the string and got food, No. 4 was looking. He pulled the string again, but not hard enough to get food, and No. 4 saw him. No. 2 did the same thing again and No. 4 saw him. The fourth time No. 2 pulled the string he got food, but No. 4 did not see. In all, No.

4 saw No. 2 at the chute and pulling the string twice; once she saw him with food at the end of the chute, and twice she got food which fell into her box.

No. 2 was now taken out and No. 4 was released from the observation box. She at once climbed the wire front opposite the chute. Then she leaned toward the chute as far as she could while still holding to the wire with one hand. She drew herself back and descended to the floor, went to the door and then to the wire end, climbed the end opposite the chute, threw her head, shoulders and arms toward the chute, catching the lower part of it in her hands. Then she let go the wire with her feet and tail and drew her body over to the chute, catching it by her feet and wrapping her tail around it. She then swung her head down under the chute and looked up into it, at the same time thrusting her hand up inside. She rattled the metal handhold against the side of the chute and in a moment pulled it. The food fell on her chest and on the floor. The interval was less than one minute, from the time No. 2 was taken from the cage. She then dropped to the floor, ate the food, and climbing the front of the cage, leaped to the chute again and repeated the act in two minutes. She repeated it again in three minutes, and again in five minutes from the time No. 2 was removed, in the meantime, eating all the food that fell to the floor. She repeated the act again in one minute and six times more within the next twelve minutes. In all she operated the mechanism eleven times in twenty minutes and ate all the food—about thirty sunflower seeds. She would now work the device as often as she got the food eaten.

Her manner of solving the problem was direct from the first, and, with one exception, without loss of time or motion.

*Summary of Behavior of No. 4 in Chute Experiment B.*

No. 4 was quite active during her first preliminary trials, but during the later ones she was more quiet and wholly indifferent to the presence of the chute. The conditions of her imitation test differed from the test of No. 13 in the fact that No. 4 herself ate some of the food that came from the chute when No. 2 pulled the string, whereas No. 13 had only seen without experiencing the result of the act. The behavior of No. 4 after being released in the cage was like that of No. 13, in that there was a marked change from the behavior of the preliminary trials. She went directly to the chute and performed the act she had witnessed, securing the same result.

TABLE 4.

NO. 4 IMITATING NO. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 4 saw.	Number of times No. 4 saw in part	Result.	Time in Seconds.
July 29.....	3	0	1	No test.	
July 29.....	4	2	2	S	55
Totals....	7	2	3	S	55

*E. Behavior of No. 11.*

*Preliminary trials.* First trial, August 24. No. 11 was very active and very hungry when put into the cage. He moved about as follows:

Across the floor to the end; up the wire and down again; to the door and looked up at the chute; chewed and pushed at the door trying to get it open; to the front and to the end; up, and back to the floor; to the door; to the front and back to the door, where he was very vigorous in his efforts to get out; to the front; up to the brace and looked all about the chute; shook the cage; to the floor and to the end; looked out through the wire; up the cage and shook it vigorously; to the door and made frantic efforts to get it open; repeated this soon again; up to *X* and perched; to the floor and about; tried the door again and walked about the floor; tried the door again and walked about the floor; up to *X* and perched; to the floor and up to the wire front; shook the cage vigorously and returned to the floor; again made frantic efforts to open the door; up to *X* and sat on the brace; to the door and frantic to open it; to the end of the cage and up the wire; around to the front and reached one arm over to the chute and shook it; to the floor and about; again climbed the front of the cage and reached to the chute; to *X* and perched.

Second trial, August 25. Behavior as follows: Up to the brace and down; repeated; while on the wire looked at the chute; shook the cage; to the end of the cage and down to the floor; looked all about; up the front and shook the cage with great vigor; down to the floor and searched about for food; up the front and shook the cage again; perched on the brace and surveyed the chute carefully for some time; perched at *X*; to the floor and sat near the end; to the front and sat looking out through the wire; to the door and tried to open it; up the front and perched at *X*; carefully surveyed the inside of the cage and looked out through the wire; looked squarely at the chute; up the front and shook the cage vigorously; back to *X* and sat for some time; to the floor and about.

Third trial, August 26. It was past feeding time and the animal was abnormally hungry. He was, therefore, fed on entering the cage, but not enough to satisfy him and he went about the cage as usual looking for food. His movements were as follows: Up the front of the cage and along the brace to the end and down to the floor; from underneath the chute he looked up at it steadily and then climbed the end to *X* where he perched and looked about the cage; shook the cage vigorously and perched again; to the floor and tried to open the door; looked toward the chute and then climbed the end of the cage to *X*; along the brace; back to *X* and to the floor; up to *X* and down the end of the cage again to the floor; sat under the chute; jumped to wire front and ran along the brace to *X*; to the floor; picked up some hulls and smelled them; repeated this several times.

Fourth trial, August 27. No. 11 behaved as follows: Up the end and down to the floor; about the floor and up the front to *X*, where he perched; to the floor and back; to the floor and sat, looking out through the wires; up the front and shook the cage; to the floor and sat at the end of the floor

of the cage; walked about the floor and climbed the front of the cage; to the floor and sat near the end of the cage; crossed the floor to the door and climbed the front wire; along the brace to X, where he perched; to the floor and looked about; to the door and up the front to X; down to the floor, where he sat looking out at the end wire; very alert, but the chute apparently had no interest for him; to the door and pushed, in an effort to get out; he had been very eager to get into the cage, but was now just as eager to get out.

Fifth trial, August 28. The behavior of No. 11 on this day was evidence that he did not expect to find food in the cage. Most of his efforts seemed to be directed toward getting out of the cage. There was no reason for his desiring to leave the cage other than the lack of interest on the inside and his desire to be back in the cage with his mate. He was not in the least frightened. His behavior was as follows: Up the end of the cage and down to the floor; up the front and down to the door; about the floor and to the top of the wire front; around to the top and down to X, where he sat for some time, uttering a cooing call; after a short time, to the floor and about; sat down near the wire end for a time; up the front and shook the cage; to X and perched; to the floor and grabbed the front wire, shaking the cage very vigorously; up to X and perched for some time; down to the floor and back up to X; along the brace and back to X, where he stayed during the remainder of the time.

*Imitation tests.*—No. 11 imitating No. 4. First test. No. 11 was placed in the observation-box, which was then placed on the floor of the cage; No. 4 was free in the cage. No. 11's record in seeing was:

Performance 1. No. 11 was distracted; saw No. 4 on the chute, but did not see the pulling of the string. He saw her eat the food on the floor.

P. 2. No. 11 saw No. 4 on the chute; saw her swinging at the end; saw her pull the string and get the food.

P. 3. No. 11 saw No. 4 leap to the chute, swing down, pull the string, and get the food.

P. 4. No. 11 saw No. 4 on the chute; saw her swing down and get the food; he jumped at the side of his box in an effort to get out.

No. 4 now spent some time on the floor getting food and No. 11 watched her attentively passing from one end to the other of his box as No. 4 walked about. Several times he jumped at her striking the side of his box; when she climbed upon his box he became very threatening.

P. 5. With his eyes No. 11 followed No. 4 about the floor and up over his box to the chute. During the pulling of the string his eyes were riveted on her. She dropped one seed in his box and he ate it.

P. 6. Same as P. 5, except that No. 11 did not get food. No. 11 was very threatening toward No. 4.

No. 4 was now removed and No. 11 was released in the cage. His first movement was to work at the door in an effort to get out of the cage. He then went up to the brace, leaned over to the chute and placing one hand on the side of it, attempted to pull it toward him; he then grabbed the edge of the lower end of the chute in his hand and pulled. Letting go of the chute

he went to *X*, where he perched for some time. Going to the floor he walked about and then looked up at the chute; he tried to jump to it from the floor, but, though he touched the rung with his hand, he was not able to hold. He then walked about the floor and climbed the front of the cage, walked along the brace and leaning over to the chute, pulled it as before. Going to the floor, he tried to climb the corner post near the chute. Failing in this, he jumped to the chute from the floor, holding with both hands. Pulling himself up to the chute, he bit the rungs and then worked his way around the chute biting at all the edges, but not turning his head down to the end of the chute. Leaping to the front of the cage, he descended to the floor and walked about. Once again he jumped for the chute, but failed to hold on. He then walked about the cage and climbed to *X*, where he perched for the remainder of the time.

Second test. Conditions were the same as in the preceding test. The record of No. 11's seeing was as follows:

Performance 1. No. 11 was looking at the experimenter and did not see.

P. 2. No. 11 saw, though his attention was divided between the experimenter and No. 4.

P. 3 to P. 5. No. 11 saw fairly well, but did not threaten as on the day before.

P. 6. No. 11 saw perfectly.

No. 4 was now removed and No. 11 was released in the cage. He found a seed on the floor and ate it. He jumped to the chute from the floor, but could not hold. Sitting down beneath the chute he looked up at it and then walked about the floor looking for food. He climbed to *X*, but returned to the floor after a minute, going to the door, where he tried to get out. Failing to open it, he went to the wire end of the cage and sat on the floor. He tried the door again and then climbed to *X*, but after one minute came to the floor and sat down. Turning toward the chute, he jumped for it, and catching hold, drew himself up to the chute. For some time he sat on the rung; then he bit his way around the chute. He then shook the chute so hard that the iron attached to the string on the inside rattled. He was then quiet, looking about the cage and at the sides and edges of the chute. Twice more he shook the chute with such vigor that he all but tore it from its fastening at the top of the cage. Becoming quiet, he sat for a moment and then leaped to the front of the cage. He went to *X* and perched for a moment; he then went to the floor and sat near the wire end of the cage. Time: 25 minutes.

Third test. No. 13 had by this time learned to get food and he was used as the imitator since, in size and general behavior he was much more like No. 11 than was No. 4. No. 11 was put into the observation-box and the box was placed on the floor of the cage. No. 13 was not at first inclined to work, but moved all about the cage. He finally went to the chute and hunted along the top of the cage for roaches. Several times he jumped from the wire side of the cage to the chute and back to the wire.

Performance 1. At last he went to the chute slowly and pulled the string, getting food. No. 11 saw every movement perfectly. No. 13 was suffering from a fall he had gotten a short time before when fighting with No. 10.

He seemed afraid of No. 11. When he would work no more, he was taken out and No. 4 was substituted.

No. 4 operated the chute eleven times. Nine of these performances No. 11 saw. He was alert and every muscle was tense.

In all, No. 11 had seen ten times during this test and a total of twenty times in the three tests.

No. 4 was now removed and No. 11 was released in the cage. He first looked over the floor for food and finding none, climbed the wire front and went over to the chute, shaking it with such vigor that he almost tore it loose from the top of the cage. Jumping back to the brace he went to X and to the floor. Passing to a position immediately under the chute he jumped up to it from the floor and climbed up on it. Without stopping to make examination he swung his body down, held to the rung with one hand, placed his feet against the back of the cage for support and, thrusting the other hand up inside the chute, pulled the string. The food fell onto his chest and on the floor. The time, from the removal of No. 4, was 60 seconds.

Having eaten the food, he again jumped to the chute and in the same position tried to pull the string, but not being able to hold his weight with one hand he had to catch with both; he then pulled himself up on the chute, and having regained his equilibrium swung down and got food as before.

Again he jumped to the chute from the floor, catching the rung in one hand and curling up so as to grasp the rung with his feet also. Then holding by his feet and one hand, he thrust the other hand into the chute as before and got food. He repeated this in exactly the same way, at once. Again he repeated this in the same way, except that he placed his feet against the back of the cage instead of on the rungs of the chute. From this time on he got food as rapidly as he could eat it, most of the time hanging below the chute with his feet braced against the back of the cage.

#### *Summary of Behavior of No. 11 in Chute Experiment B.*

No. 11's preliminary trials were much like those of No. 13 and No. 4. They ended with No. 11 not having got food and with his being indifferent to the means of getting it. The stimulus-complex was the same as in the case of No. 4, *i. e.*, No. 11 saw No. 4 getting the food and experienced the result of her act himself. When he was released from the observation-box, his behavior was different from what it had been in the preliminary trials. However, it was not sufficiently like the behavior of No. 4 to bring the same result. His attention had been directed to the chute, but not to that part of it which would enable him to get food.

After his second observation his interest in the chute seemed increased, as evidenced by the great vigor with which he shook it. The third test seemed to direct his attention to the important part of the mechanism and he succeeded in getting food as No. 4 had done in his presence. The result, in the case of No. 11, differed from the result in each of the previous cases

in that No. 13 and No. 4 both repeated the act which they had seen *immediately*. No. 11, on the other hand, seemed to learn a part of the act at a time, and only after repeated opportunity to see it, did he learn fully to attend to the act as it was performed in his presence.

TABLE 5.  
No. 11 IMITATING No. 4.

Date.	Number of times No. 4 performed the act.	Number of times No. 11 saw.	Number of times No. 11 saw in part.	Result.	Time in minutes.
Aug. 28.....	6	5	1	F	10
Aug. 28.....	6	5		F	10
Aug. 29.....	12	10		S	1
Total.....	24	20	1	S	21

*F. Behavior of No. 6*

*Preliminary trials.*—First trial. The first few minutes were spent on the floor. After four minutes No. 6 climbed the cage front and reached to the chute with his hands. He repeated this a minute later. A minute later he looked at the chute from the floor, climbed the front of the cage and grabbed the lower edge of the chute in his hands. This he repeated once, and then spent the rest of the time on the floor of the cage.

Second trial. On the second day No. 6 climbed about the cage, then reached to the chute and put one hand slightly into the end of it. He gave no further attention to it and went to the floor. Later, he climbed the front and while holding with tail and feet to the wire reached to the chute, clasping a hand on each side of it about four inches from bottom. This he repeated after eight minutes, and once more before the close of the time.

Third trial. On the third day, No. 6 reached to the chute as on the previous day, after five minutes in the cage. Later, he reached to the chute and tried to get his hands and feet on it while holding to the wire with his tail.

Fourth trial. On the fourth day his only attention to the chute was to look at it once and to attempt to get to it as on the previous day while holding to the wire with his tail. Failing, he spent the rest of his time on the floor.

Fifth trial. On the fifth day No. 6 once climbed the wire and looked at the chute. Later, after running about the floor, he climbed the front of the cage and jumped to the chute to get a cockroach on the back of the cage. While there he explored the top of the cage and jumped back to the side. Once more he leaped to the chute, but he leaped back immediately. During the latter part of the time he remained quietly on the floor of the cage.

*Imitation tests.*—No. 6 imitating No. 2.—First test. No. 6 was put into the observation-box, which was set on the bottom of the experiment cage. No. 2 was free in the cage. No. 2 was interested in No. 6 and pretended fight. Once he ran up the wire, jumped to the chute and leaped to the wire again



at once. Then both animals pretended fight toward another animal which was making a noise behind a curtain.

Performance 1. No. 2 jumped to the chute and jumped back to the wire without pulling the string. No. 6 saw.

P. 2. No. 2 jumped to the chute and pulled the string. No. 6 saw No. 2 on the chute and saw food fall.

P. 3. No. 6 saw as before. An empty shell bounced into the box and No. 6 got it.

P. 4. No. 6 saw No. 2 on the chute, looked away, heard the sound of the trap door, looked back and saw No. 2 at the end of the chute and the food falling to the floor. No. 2 now jumped to the chute twice, but he did not pull the string. No. 6 saw him jump.

P. 5. No. 2 jumped to the chute, pulled the string and the food fell to the floor. No. 2 now jumped to the chute and jumped back to the wire. No. 6 saw nothing No. 2 did.

P. 6. No. 6 saw the entire performance.

No. 2 was now taken out. No. 6 was released from the observation-box. He climbed the cage at the front and reaching over to the chute pushed a hand up inside. He could not reach the string. This occurred only 30 seconds from time of release. He then went down to the floor.

Immediately, he climbed the wire opposite the chute, jumped to it, threw his head and shoulders down, reached up inside and pulled at the string, but, though he gave what seemed a strong pull, it was not sufficient to open the trap door. He raised his body up, but at once bent down again and looked up the chute. He then leaped to the floor. All this happened within two minutes from the time of his release from the observation-box.

Four minutes later he repeated the entire performance, and then dropped to the floor. Four minutes later he leaped to the chute, but did not go to the end of it. He explored the top of the cage instead, leaped back to the wire, and went down to the floor. He did not seem as vigorous as usual.

Three minutes later, he jumped to the chute and in attempting to get in position at the bottom of the chute, lost his hold and dropped to the floor.

This he repeated five minutes later. He held with one hand to the rungs on the chute and allowed his feet and body to hang below. Holding thus with one hand, he tried to put the other up the inside of the chute and being unable to hold himself longer dropped to the floor.

Five minutes later he jumped to the chute and pulled the string, but not hard enough to get the food.

Second test. Conditions were the same as in the previous test. No. 2 was now more active and worked rapidly.

Performance 1 to P. 2. No. 6 saw No. 2 jump to the chute, then looked away, heard the rattle at the chute and looked back to see No. 2 at the end of the chute and food falling to the floor.

Six times more No. 2 operated the chute. No. 6 saw the entire performance each time but one; this one he saw in part.

When No. 2 was out No. 6 found a grain of food on the floor of the cage and ate it. He then climbed the wire, jumped to the chute, and swing-

ing down to the end of the chute pulled the string, but failed to get food. Then he swung down to the floor. Time: one minute. He tried again immediately, but failed to hold and dropped to the floor. After six minutes he jumped to the chute, touched the string with his hand, but did not pull it.

Third test. Conditions were the same as in the previous test.

Performance 1. No. 6 was playing and saw only in part.

P. 2. No. 6 saw the entire performance, though not steadily.

P. 3. No. 6 saw the entire performance.

No. 6 now became angry at No. 2 and tried to get out of his box. No. 2 became frightened and ceased to work for some time. He lay stretched out on the floor and after repeated efforts to get him to work he was taken out, and No. 6 was released in the cage.

No. 6 immediately climbed the front of the cage, leaped across to the chute, swung with one hand to the rung, looked up the chute, pushed his other hand up, lost his grip and fell to the floor. He repeated this within two minutes. Twice again within two minutes he jumped to the chute. Then he jumped to the chute, hung by one hand and looked up inside. He looked at the chute often. He tried again to hang by one hand and look up the chute, but dropped to the floor. He later jumped to the chute twice and looked at the top of the cage.

Fourth test, No. 6 imitating No. 4. Same conditions as before, except that No. 4 was substituted for No. 2.

No. 4 got food fourteen times. No. 6 saw the entire performance five times; seven times he saw the performance in part.

After No. 4 was removed and No. 6 was released, the latter went at once to the front, climbed the wire, jumped to the chute, held by his right hand and touched the string. Then he changed to hold by his left hand and thrust his right hand up to touch the string. After this he dropped to the floor. He repeated this in less than two minutes, not changing hands while on the chute, however. Five minutes later he leaped to the chute, but did not swing down. He did not seem to "get the hang" of holding to the chute with his feet as some of the other animals did. He gave no further attention to the chute.

Fifth test. The conditions were the same as in the preceding test. No. 6's record in seeing No. 4 was:

Performance 1. No. 6 only saw food strike floor.

P. 2 to P. 10. No. 6 saw the entire performance.

P. 11. No. 6 saw in part.

P. 12. No. 6 saw the entire performance.

No. 4 was taken out and No. 6 was released. No. 6 found a seed on the floor and ate it. After two minutes, No. 6 jumped to the chute, but only examined a crack in the cage door. At the end of five minutes, No. 6 jumped to the chute and searched the inside of the chute with his hand, but he did not pull the string. He then took his leisure about the cage till the end of 10 minutes.

*Summary of Behavior of No. 6 in Chute Experiment B.*

No. 6 differed from each of the previously mentioned animals in his preliminary trials. He gave some attention to the end of the chute, on the second day, putting one hand into the end of it a short distance. On the later days, however, he ignored the end of the chute entirely. The stimulus-complex in the first test was the same as in the case of No. 13, namely, the sight of another animal performing an act and getting food thereby. The effect on No. 6 was evident, for within thirty seconds after being released in the cage he had repeated a part of the act he had seen; within a minute he had tried again and repeated the act in every particular, except in the amount of force with which he pulled. This difference, however, kept him from getting the food. Although he failed, he repeated the act entire or in part several times during the next few minutes.

After his second series of observations, he repeated the entire act again, but failed to exert sufficient strength to accomplish the result. During the succeeding tests he persisted in going to the chute, although he ceased to pull the string. He did not cease to investigate the inside of the chute with eyes and hands, although his only means of connecting the chute with food had been his observation of another animal getting food at the chute.

TABLE 6.

## No. 6 IMITATING No. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 6 saw.	Number of times No. 6 saw in part.	Result.	Time in minutes.
Aug. 5.....	5	2	3	S	2
Aug. 5.....	8	5	3	S	10
Aug. 5.....	3	2	1	S	18

## No. 6 IMITATING No. 4.

Aug. 6.....	14	5	7	S	10
Aug. 7.....	12	10	1	S	10
Total.....	41	24	15	S	50

*G. Behavior of No. 5.*

*Preliminary trials.—First trial, July 30.*—Within one minute after entering the cage, No. 5 had climbed to the chute and had found the string with her hand. She was able to reach the chute from the side of the cage by help of her long legs and tail, which supported her while she grasped the chute in her hands. Later she reached the chute from the end of the cage. Then she swung to it from the side and looked up at the end. She then tried to use her foot to pull the string, and failing, climbed up the chute and examined the top of the cage. Then she braced her feet against the

corner post and pushed the chute with her hands. She was taken with sneezing and, descending, rubbed her nose on the floor. Her time was up soon after this.

Second trial, July 31. On the second day No. 5 reached to the chute with her hands, put one hand up the inside and pulled at the string, but not hard enough to cause the food to drop. Five minutes later she did the same except that she did not pull the string. After the next five minutes she climbed up on the chute and examined the top of the cage. Then she swung her head and shoulders down, touched the string with her hand and dropped to the floor.

Third trial, July 31. On the third day No. 5 was quiet about the cage as if nothing interesting were present. She spent most of her time on the floor.

Fourth trial, August 1. No. 5 ran up and down the wire several times. Then she surveyed the chute and the whole top of the cage from below. She climbed to the chute and examined the top and back of the cage. Then she remained quietly on the floor for ten minutes, after which she looked up at the chute, climbed the cage, reached the chute and struck at the string several times with her hand.

Fifth trial, August 1. At the fifth trial No. 5 was indifferent in the cage for five minutes. Then she climbed to the chute, examined the top of the cage, threw her head down, reached to the string and played with it but did not pull it. Later she jumped to the chute again and examined the back of the cage. The remainder of the time she spent on the floor.

*Imitation tests.—No. 5 imitating No. 2.*—First test. No. 2 and No. 5 were put into the cage together. After a little time No. 2 jumped to the chute. No. 5 climbed the wire opposite the chute, leaned over, put her hand up the inside and touched the string, but did not pull it. No. 5 then went to the floor and No. 2 pulled the string. Two seeds fell to the floor and No. 5 got them. No. 5 did not see the string pulled. The second time No. 2 pulled the string, No. 5 did not see. She heard the seeds drop to the floor and got them, jumping down from the wire front ahead of No. 2. The third time, No. 5 heard No. 2 at the chute and looked up just in time to see him pull the string and to see the seeds fall. No. 5 then went up the wire, jumped to the chute, and tried to pull the string, but did not pull hard enough to get food. No. 2 then became excited and refused to work.

Second test. No. 5 was put into the observation-box and the box was set on the floor of the cage. No. 2 was put into the cage and at once went to work.

Performance 1 to P. 5. No. 5 saw No. 2 on the chute and saw the food drop. She did not see him pull the string.

P. 6. She saw the entire performance.

P. 7. She saw it in part.

When No. 2 was out No. 5 was released. She climbed the front of the cage and leaning over to the chute tried to put one hand up the inside, but could not do it. Time: 50 seconds. She went down to the floor and at once climbed the wire again. She jumped to the chute, wrapped her tail around it, put her feet on the rung, threw head and shoulders down and

looked up inside the chute. She put her hand up and was in the midst of an interested examination when a sneeze from the side cage startled her and she dropped to the floor. Her examination was more direct and longer than at any previous time.

She climbed the cage, jumped to the chute and repeated the examination a minute later. Then she dropped to the floor and wandered about. Six minutes later she jumped to the chute, but only examined the top of the cage.

Third test. No. 5 was not attentive to No. 2. The latter got food seventeen times. Of these performances, No. 5 saw but five; six times she saw in part.

No. 2 was then removed and No. 5 was released from the observation-box. For a time she searched the floor and edges for food. After three minutes she climbed the wire, reached to the chute with her hands and tried to put one hand up the inside, but failed. Then she climbed down to the floor and sat in the corner.

Later she vomited grass which she had eaten out of her bedding and then went about the cage quietly. Her lack of activity was probably due to sickness of stomach.

Fourth test. The box containing No. 5 was fastened to the side of the cage on a level with the lower part of the chute. No. 4 was used instead of No. 2.

Performance 1 and P. 2. No. 5 saw all except No. 4's putting his hand up.

P. 3 and P. 5. No. 5 saw entire performance.

P. 4. No. 5 saw nothing.

P. 6 and P. 7. No. 5 was not interested in No. 4 on the chute; she bowed her head and slept while No. 4 got food.

P. 8 to P. 10. No. 5 saw the entire performance.

No. 4 was now taken out and No. 5 was released from the observation-box. She went at once to the front, climbed the wire, reached to the chute, put one hand up and pulled, but not hard enough to get food. No. 5 was somewhat frightened by the demonstrations of anger which No. 4 made when she was taken out of the cage. No. 5 gave no further attention to the chute during the ten minutes.

Fifth test. No. 5 was put into a box on the floor where she could see No. 2 at the chute. Her record in seeing No. 2 pull the string was as follows:

Performance 1. No. 5 saw nothing.

P. 2. No. 5 saw entire performance.

P. 3 and P. 4. No. 5 saw in part.

Here the apparatus gave some trouble and the test was delayed.

P. 5. No. 5 did not see.

P. 6 and P. 7. No. 5 saw the entire performance.

P. 8 and P. 9. No. 5 did not see the pull; saw food strike floor.

P. 10 and P. 11. No. 5 saw perfectly.

No. 2 was taken out and No. 5 was released. Immediately she climbed to the chute and pulled the string, but not hard enough to get food. Time: 40 seconds. A minute later she threw her head down and looked up the inside

of chute. Later she climbed to the chute, but paid no attention to it. Nor did she pay any more attention to it during the entire time in the cage.

Sixth test. The conditions were the same as in the previous test, except that the string in the chute was lengthened four cm. Of seventeen performances No. 5 saw five completely, six in part, and six not at all. Toward the end of the time she seemed sleepy and paid but little attention.

When No. 2 was out and No. 5 was released she at once climbed to the chute and took a long, steady look up the inside of it, but did not put her hand up. Time: 40 seconds. She then took her leisure about the cage, caught a roach and perched on the brace.

*Summary of Behavior of No. 5 in Chute Experiment B.*

No. 5 did not present the same problem in the imitation tests as the animals previously discussed. She had already performed every part of the act necessary to get food. She had evidently failed because of not exerting sufficient strength. Her interest in the chute seemed to wane in the fourth and fifth preliminary trials and to be accentuated after observing No. 2 in the first and second tests. During the later tests she repeated the act of the animal seen, but she never got the food, and in the fifth test she merely looked up the inside of the chute without putting her hand in.

It seems fair to infer that the increase of interest manifested in the first and second tests and the continuation of interest in the chute through the successive tests was due to No. 5 seeing the other animals getting food at the end of the chute.

TABLE 7.

No. 5 IMITATING No. 2. No. 5 IMITATING No. 4.

Date.	Number of times No. 2 performed the act.	Number of times No. 5 saw.	Number of times No. 5 saw in part.	Result.	Time in minutes.
Aug. 4.....	3	1	0	F	
Aug. 5.....	7	1	6	S	10
Aug. 5.....	17	5	6	S	10
Aug. 6.....	10	5	2	S	10
Aug. 7.....	11	5	2	S	10
Aug. 7.....	17	5	6	S	10
Totals....	65	22	22	S	50

*H. Behavior of No. 3.*

*Preliminary trials.*—First trial. No. 3 moved about slowly in the cage during the entire fifteen minutes, but gave no attention to the device for getting food. He spent his time on the floor and the wire parts of the cage.

Second trial. No. 3 spent the first few minutes on the floor and then climbed the wire and came back to the floor several times. Once when on

the wire front he looked steadily at the chute. Then he climbed about the cage and played on the floor. Once again he took a direct look at the chute from the front of the cage and then played about on the floor.

Third trial. On the third day No. 3 climbed the wire and played on the floor, but paid no attention to the chute.

Fourth trial. On the fourth day he climbed the wire and then spent his time on the floor, going from one corner to another and crouching with his face toward the center of the cage. Occasionally he surveyed the top of the cage. Then he climbed to the brace (across front of cage) and perched. Later he went to sleep on the floor in the corner. Then he climbed the cage and looked about, but took no notice of the chute during the fifteen minutes.

Fifth trial. On the fifth day he remained on the floor for a minute and then climbed the wire. He then sat in the corner of the cage for five minutes before he climbed the wire again. Then he went to rest in another corner. No attention to the chute.

*Imitation tests.—No. 3 imitating No. 2.*—First test. No. 2 and No. 3 were put into the cage together. No. 3 was attentive to No. 2 from the first, partly in order to escape punishment. Each time No. 2 pulled the string, No. 3 got food, and when he got a grain of sunflower seed the second time, No. 2 punished him. No. 3 cried and saw only in part the next time. Three times he saw the whole performance from the floor at different angles and twice from the front of the cage on a level with the chute.

After No. 2 had been taken out No. 3 busied himself on the floor for a few minutes picking over the hulls No. 2 had left. Then he surveyed the chute from the four corners (on the floor) of the cage. Once he climbed the front wire and looked at the chute from its own level. Then he went to the floor and rested in the corner of the cage.

Second test. Conditions were the same as in the previous test. No. 3 was again afraid of No. 2 after the second drop of food. He saw the first two times perfectly from the floor, but missed the third because of his fear of No. 2. The next three times he saw the entire performance from the floor.

With No. 2 out No. 3 went hunting among the empty hulls as before. Then he looked upward toward the chute several times from different positions on the floor. Later he climbed the front of the cage opposite the chute and looked back over his shoulders at it. Then he went down to the floor and remained there.

Third test. Conditions were the same as in the preceding tests. No. 3 was attentive to every move of No. 2 and saw him jump to the chute and pull the string each time but one. He did not get food, however, because of his fear of punishment. At the seventh time, No. 3 got food. Although No. 3 looked steadily at No. 2 when he pulled, it was difficult for him to see No. 2's hand go up the chute because No. 2's body often got in the way.

The first five minutes after No. 2 was out No. 3 was on the floor hunting over hulls dropped by No. 2 and fingering the cracks in the floor. Several

times he looked up at the chute. Then he climbed the cage wire, but did not look at the chute. Later, when under the chute, he looked at it steadily and then started for the front as if to climb, but was turned away by seeing a hull on the floor.

Fourth test. The conditions were the same as in the preceding tests. No. 2 got food fourteen times. Ten of these performances No. 3 saw completely; the other four he saw in part. He kept away from No. 2 because No. 2 slapped him.

When No. 2 was out No. 3 spent his time on the floor hunting over empty hulls and paid absolutely no attention to the chute during the entire time. No. 3 was so little influenced by seeing No. 2 obtain food that it seemed useless to continue the tests longer. They were, therefore, discontinued.

*Summary of Behavior of No. 3 in Chute Experiment B.*

No. 3 was not nearly so active in the preliminary trials as the animals previously discussed. In the imitation tests he seemed to see what was done. What he saw, however, did not seem to influence his behavior in any way unless it was to increase his looking at the chute. He failed to make any effort to get the food for himself.

TABLE 8.

No. 3 IMITATING No. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 3 saw.	Number of times No. 3 saw in part.	Result.	Time in minutes.
Aug. 3 . . . . .	8	5	4	F	10
Aug. 3 . . . . .	6	5		F	10
Aug. 3 . . . . .	11	10		F	10
Aug. 5 . . . . .	14	10	4	F	10
Total . . . . .	39	30	8	F	40

*General Summary of Results of Chute Experiment A and Chute Experiment B.*

Taking Chute Experiment B as a whole, we have to consider six animals, no two of which exhibited exactly the same behavior. In the cases of No. 13, No. 4, No. 11 and No. 6, there is a similarity in that each animal showed a *decided change of behavior after witnessing another animal get food from the chute*. Each of these animals repeated with more or less exactness of detail the act which it had seen the other animal perform. Without meaning to imply



anything as to the mental processes accompanying it, I shall call such behavior *imitation*. As I shall use it in this paper, the word imitation is a conceptual short cut to describe a complex form of behavior. It always implies these things: (a) The animal which imitates observes an act of another animal; (b) More or less directly thereafter its behavior is modified in the direction of the act observed; (c) This modification is usually sudden; (d) The behavior is changed to a considerable degree and, when wholly successful, to an exact copy of the act observed. In every case of behavior which I shall call imitative, the animal had abundant opportunity to learn the act by himself so that his repeating the act of the imitatee was apparently due to his observation of that animal performing.

In the case of No. 3 and in the case of No. 1 in Chute Experiment A, there was almost no evidence that the act of the performing animal influenced the animal which saw.

The case of No. 5 is unique. Before seeing another animal perform the act, she had herself done every part of the act necessary to get food. The only way in which she could have been influenced was by being stimulated to exert more force on the pull or by being stimulated to a repetition of the act. She was not influenced in the first way, but the regularity with which she went to the chute after seeing the other animal get food, suggests that she was influenced in the second way. In her habits, she was much like No. 4 and No. 6, and the clear evidence for imitation in the conduct of each of these animals furnishes some ground for a similar interpretation of the behavior of No. 5. However, the evidence on the point is not conclusive and remains rather a conviction in the mind of the experimenter than an established fact.

TABLE 9.

## RESULTS OF CHUTE EXPERIMENT A AND CHUTE EXPERIMENT B.

## I.

Number of animals used.....	7
Cases of successful imitation.....	3
Cases of partially successful imitation.....	2
Cases of failure to imitate.....	2

TABLE 9. (Continued.)

## RESULTS OF CHUTE EXPERIMENT A AND CHUTE EXPERIMENT B.

## II.

Cases of imitation when the imitator was confined during the activity of the imitatee.....	5
Cases of imitation when both animals were together in the cage.....	0

## III.

Cases of immediate imitation.....	4
Cases of gradual imitation.....	1

## IV.

Cases of imitation in which the imitating animal <i>did not</i> himself experience the result of the act before performing.....	3
Cases of imitation in which the imitating animal <i>did</i> experience the result of the act before performing it.....	2

## 3. ROPE EXPERIMENT.

*A. Description of Device.*

For this experiment a hole 5 cm. square was cut in board *D*, 26 cm. from the top of the cage, fig. 5. A door was hinged to one side and opened outward. It was cut so as to fit snugly and when closed was flush with the inside of the board. The only evidence of an opening was the sharp line around the square where the door fitted the board. Before this door, and 27 cm. from it, an inch rope, *b*, hung from a screw eye in the top of the cage to the floor.

In order to get food the animal must climb the rope and, while supporting himself on the rope, push the door open, reach through it and get the food on the outside of the cage. The food was supplied by means of a two-inch leatherette belt connected with the experimenter's table, which stood four feet from the cage. This convenience, together with a string by which the door could be closed after the animal had opened it, made it possible to manage the entire apparatus from the experimenter's table.

There was nothing on the inside of the cage to denote the food on the outside.

*B. Behavior of No. 2.*

*Preliminary trials.*—The following preliminary observations were made in the old cage at the Harvard Laboratory. Each trial lasted 30 minutes.

First trial. At first No. 2 walked about the floor and climbed the front of the cage. He then went about the cage, and once, in passing, touched the rope with his hand. Again he touched it as he went about the cage. He was very active and ran about the cage very rapidly, but made no effort to climb the rope.

Second trial. On the second day the experiment was disturbed by No. 2 getting out of the cage. During the time he was in the cage he made no effort to climb the rope.

Third trial. On the third day he went rapidly about the cage as on the first day. Once, in passing, he picked up the end of the rope. During the thirty minutes, however, he made no effort to climb it.

Fourth trial. On the fourth day No. 2 was quite active and kept moving during the entire thirty minutes, passing over every bit of floor space many times and being repeatedly on every part of the front and end of the cage. He noticed the rope only to touch it momentarily in passing.

Fifth trial. On the fifth day No. 2 was active and eager to get out of the cage. Once he grabbed the rope in his tail and ran up the front of the cage. Later he bit the end of the rope once.

Sixth trial. On the sixth day he was very wild, possibly due to the death of his mate the day before. He made no effort to climb the rope.

Seventh trial. On the seventh day No. 2 behaved as usual. His only notice of the rope was to push it aside in passing.

Eighth trial. No. 2 behaved as usual. Once he stood on his feet and grasped the rope with his hands one above the other as if to climb.

Ninth trial. On this day No. 2 grasped the rope once in the same manner as on the previous day, but let go of it at once. He repeated this several times, but showed no other intention of climbing. He did not look up when holding the rope.

Tenth trial. On the tenth day he went about the cage in his usual way. Once or twice he hooked his tail around the rope and ran up the front of the cage, dropping the rope when half way up.

Eleventh trial. On the eleventh and twelfth days he went about the cage as usual and displayed no interest in the rope.

*Imitation tests.—No. 2 imitating No. 3.*—These tests were made in New York. Both animals were in the cage together.

First test. No. 3 got food twelve times. Ten times No. 2 saw him eating the food and once saw the entire performance. Twice when watching No. 3 eat while on the rope, No. 2 climbed the front wire and leaned toward the rope as if trying to get to the door. During the rest of the time No. 2 was distracted by the other monkeys in the living cages nearby.

Second test. No. 3 was very active and climbed the rope often and rapidly. No. 2 was not accustomed to watch No. 3 and did not look at him, but tried to see out the window and into the other cages. Four times when No. 2 saw No. 3 on the rope he leaned out from the side of the cage toward the rope. Once when No. 3 pushed the rope toward the front of the cage No. 2 caught it in his hands and swung his weight on his hands, but held on to the wire with his feet and tail. Several times when No. 3 was up the rope No. 2 caught the end of it from the floor. No. 2 saw five times in fourteen. When No. 3 was taken out after performing the trick fourteen times, No. 2 tried to climb the post in the corner next to the rope and got two feet from the floor by the help of small sticks nailed to the post. Then he stood on the floor and grasped the rope in

both hands as if to climb, but although he looked up, he did not lift himself from the floor. He tried to climb the post again as before, but when he failed he did not turn to the rope at once; he did, however, a moment later. During the last five minutes of the fifteen he remained in the cage after No. 3 was out, he sat in the corner near the rope, part of the time holding it in his hands.

Third test. No. 2 was more or less distracted by other monkeys in the room and not being very hungry did not observe No. 3 closely. He saw the whole act five times in twelve. He did not watch from first to last. It was counted if he saw No. 3 climb the rope and also get the food, even though his attention was not continuous. In no case, however, did No. 2 watch No. 3 continuously from the time he left the floor until he got the food. No. 2 saw by glances only. Three times he swung out from the wire front and twice he tried to climb the post as in the previous test.

When No. 3 was taken out No. 2 ran about the cage. He grasped the end of the rope when on the floor. He looked up at the door and tried to climb the post. Then he grasped the rope with one hand above the other as if to climb. Dropping the rope he turned to the post, then back to the rope, grasping it in his hands and bearing part of his weight on it. It swung and he took a few steps. Again he grasped the rope and bit the end of it. Then he grasped it with two hands and one foot. Then he turned to the post and put his hands and one foot on it. Then on the other foot he turned as on a pivot and grasped the rope with the three members he had placed on the post. Then he ran to the front of the cage and back to the rope, grasping it again with two hands and one foot and bearing some weight on it, but not enough to lift the other foot from the ground. Then he grasped the rope in his hands and rushed to the wire to climb. This he repeated, wholly or in part, several times more in the next two minutes. He was then taken out twenty minutes after No. 3 had been removed.

Fourth test. When No. 2 and No. 3 came into the cage together No. 2 was very attentive to everything No. 3 did and looked often toward the food door. When No. 3 climbed the rope, No. 2 climbed the wire front of the cage on the first and second trials. When No. 3 pushed against the door with his hands his feet pushed the rope over toward No. 2, who was on the wire front of the cage. No. 2 was eager to grasp the rope and once did grasp it in his hands, but would not let go of the wire with his feet. When No. 3 got the food the rope swung back to a perpendicular position, and No. 2, holding with feet and tail to the wire, threw his body out toward the rope. He repeated this motion several times, and when No. 3 got food the third time No. 2 was able to grab it out of his hands. This he did on the fourth and fifth trials also. No. 3 was then removed and No. 2 became very active on the wire, throwing his body vigorously toward the rope, and failing to grasp it, he repeated the act at once. His motions increased and he seemed frantic to catch the rope. Finally he jumped, catching the rope and holding. At once he jumped back to the wire, and ran down to the floor; he quickly climbed the rope

twice and then jumped from the rope to the wire. Then he climbed the rope, opened the door by pushing on it with his teeth as No. 3 had done, and got food. Next he tried to climb the post in the corner, and then ran up the rope again and got the food. During the next ten minutes he climbed the rope twelve times, getting food most of the times.

*Summary of Behavior of No. 2 in the Rope Experiment.*

No. 2 during a long series of preliminary trials did not climb the rope nor pay any attention to it or to the food door. During the first imitation tests he was not attentive to No. 3, but gradually became so as he saw him getting food, and in the last test his attention was riveted on No. 3 during the whole of the time No. 3 was in the cage. His learning to do what No. 3 did was also a gradual process. When his attention was directed to the food door his first effort to get to it was by climbing the wire front of the cage. His next step was to learn to bear a portion of his weight on the rope. When he got food from No. 3 there was a noticeable increase in his apparent desire to get to the door. The stimulation seemed to increase steadily until finally it forced him to leap to the rope and back to the wire and then to climb the rope from the floor. Once on the rope, he repeated exactly the act of No. 3 and got food in the same way.

TABLE 10.

NO. 2 IMITATING NO. 3.

Date.	Number of times No. 3 performed the act.	Number of times No. 2 saw.	Number of times No. 2 saw in part.	Result.	Time in minutes.
July 1.....	11	1	10	F	10
July 2.....	14	5	8	F	10
July 3.....	12	5	7	F	10
July 4.....	5	5		S	
Total.....	42	16	25	S	30

*C. Behavior of No. 4.*

*Preliminary trials.*—First trial. No. 4 spent the first few minutes on the floor picking over nut hulls. Then she became very active about the cage. She climbed the rope and investigated the top of the cage and the cracks between the boards. She spent the most of the remaining time on the floor.

Second trial. On the second day No. 4 spent most of the time on the floor swaying back and forth before the door. Nothing inside seemed to interest her and she wanted to get out. Twice she climbed the wire slowly, but paid no attention to the rope.

Third trial. On the third day No. 4 was not so active as usual and perched on the brace most of the time. She gave no attention to the rope.

Fourth trial. On the fourth day No. 4 behaved as usual, spending most of her time on the wire and brace. When on the floor she swayed back and forth before the wire and gave no attention to the rope.

Fifth trial. On the fifth day No. 4 spent most of her time in the corner of the cage farthest from the rope and gave no attention whatever to it.

*Imitation tests.—No. 4 imitating No. 2.*—First test. No. 4 was placed in the observation-box which was fastened to the front of the cage on a level with the food door.

No. 4 was on the floor of the observation-box. She was swaying as usual and this somewhat frightened No. 2, so that he climbed the rope only after three minutes and then jumped to the wire without getting food. This he repeated three times. Then he climbed the rope, tried the door, but failed to push it open. He jumped to the wire at once, after pushing. Then he climbed the rope and opened the door. No. 4 saw in part. No. 2 then tried the door four times unsuccessfully. Climbing the rope brought him close to No. 4 and his fear did not allow him to make a good effort. Then he climbed the rope and opened the door, getting food. No. 4 saw the entire performance.

No. 2 was then removed and No. 4 was released. She climbed the wire on the front of the cage and then on the end. Then she climbed the rope and reached to the hole in the top of the cage. She looked at the door, put her nose to it, and jumped to the front wire, and went to the floor. She then climbed up and down the front and climbed the rope looking at the door and jumping to the front of the cage. Again, she climbed the rope and looked all about the door more intently than before. She returned to the floor, climbed the end of the cage and perched on the brace at X. Again she climbed the rope, examined the top of it, and looked all about the door. Then she became interested in out of doors and soon her time was up.

Second test. No. 4 was in the box as before and No. 2 was somewhat slow and fearful. No. 4 saw five of No. 2's twelve performances completely; four other times she saw a part of the performance.

No. 2 was removed and No. 4 was released. She climbed the rope at once (5 seconds) and smelled and licked the door. Then she returned to the floor. She again climbed the rope and examined the top of it. She looked at the food door carefully, but after coming to the floor she gave no further attention to the rope or the door.

*No. 4 imitating No. 6.\**—Third test. No. 4 was in the box on the floor.

Performance 1. No. 6 climbed at once to the door, pushed it open with his hand and got food. No. 4 saw him smacking his lips when the food was gone, but saw nothing more.

P. 2. No. 4 saw No. 6 reach through the open door and get food, but saw nothing more.

In the sixteen following performances No. 4 saw the entire performance

\*The behavior of No. 6 will be given later, page 385.

twice; she saw No. 6 climb the rope three times, and eleven times she saw nothing.

No. 6 was removed and No. 4 was released. She at once climbed the rope and looked about the food door, but made no effort to open it. She examined the hole in the top and returned to the floor. She climbed the front of the cage and leaped to the rope. She looked at the door, put her palm against it and rubbed her hand over the door. She then fingered the crack around the door, but did not push the door open. She returned to the floor and worked about the edges of the floor for some time. She then climbed the rope, but gave no attention to the door. After a little more wandering she perched on the brace at X and remained quiet.

Fourth test. No. 4 was put in the observation-box on a level with the food door.

Performance 1. No. 4 saw the entire performance.

P. 2. No. 4 saw the entire performance. No. 6 hesitated to climb for fear of No. 4.

P. 3. No. 6 was slow at the door because of watching No. 4 and No. 4 saw perfectly every move.

P. 4 and P. 5. No. 4 saw all except the push on the door. She looked down just as No. 6 pushed.

P. 6 and P. 7. No. 4 saw perfectly.

No. 6 was removed and No. 4 was released; she ran up the rope and put her nose to the food door, but gave no push. She returned to the floor and climbed the wire end and front and examined the edge of the cage door. She spent the remainder of her time without attention to the door or the rope. Later she perched on the brace at X and "hunted fleas."

Fifth test. No. 4 was in the box on a level with the door. No. 6 climbed the rope and opened the door nine times. No. 4 saw every part of the performance five times; three times she saw in part.

When No. 4 was released she at once climbed the rope and looked at the food door. Then she jumped to the wire front and returned to the floor. She examined about the floor edges and climbed up and down the wire. Then she climbed the rope and passed her hand over the food door, but did not push with any force. She then looked at the top of the cage and leaped to the wire front. She perched on the brace at X for the last five minutes.

Sixth test. No. 4 was in the box on a level with the food door. No. 6 got food seventeen times. No. 4 saw the entire performance eight times; once she saw in part.

No. 6 was removed and No. 4 was released. She walked across the floor to the wire end and climbed half way up. Then she leisurely climbed down and walked over to the corner opposite the rope, turned to the rope and climbed it. She stopped exactly at the door, put her right hand against the upper edge of the door, her fingers striking the board above, and pushed. Failing to open the door, she put her left hand lower down on the door, her palm this time striking the board below the door. She pushed again, but failed to open the door, probably because more of the

force of her effort affected the board than the door. Then she changed back to the right hand and planted it squarely in the center of the door, neither her fingers nor palm touching the board. She gave a hard push and the door opened. Time: two minutes. She got the piece of food near the door and thrust her arm farther out and got the piece of banana on the place next below. Then she pushed the door open as fast as I closed it and got food three times. This she repeated ten times as rapidly as the device was reset.

Her hand when placed flat against the door reached from the top to the bottom and was almost as broad as the door. To open the door she must place her hand in the center of it, in order not to strike the edges of the board in some place.

*Summary of Behavior of No. 4 in the Rope Experiment.*

The problem as it came to No. 4 was different from the problem of No. 2. She did not need to learn to climb the rope. She did this as if it were a familiar act during her first few minutes in the cage. What she had to learn was to open the food door. Her own unaided efforts helped her not at all, and during the last four preliminary trials she kept entirely away from the rope. Her first observation of the imitator attracted her again to the rope and to the food door, but she did nothing except to nose about the door. Her second test again directed her attention to the door and possibly increased that attention. The third test augmented her attention to the door and she rubbed her palm over it and fingered the edges. After the fourth test her interest seemed to lag, but after the fifth her attention was as great as after the third. In both the third and fifth tests she used her hand at the proper place and in much the same manner as had the performing animal. The sixth test served to make

TABLE 11.

No. 4 IMITATING No. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 4 saw.	Number of times No. 4 saw in part.	Result.	Time in minutes.
Aug. 10.....	2	1	1	F	10
Aug. 10.....	12	5	4	F	10

No. 4 IMITATING No. 6.

Aug. 11.....	18	2	4	F	10
Aug. 11.....	7	5	2	F	10
Aug. 12.....	9	5	3	F	10
Aug. 12.....	17	8	1	S	2
Totals....	65	26	15	S	52



definite the imitative behavior. She repeatedly tried to do what she had seen done and finally succeeded. At no time, until she performed the act herself, did she experience the result of the act, the stimulus-complex being the other animal performing an act and getting food.

*D. Behavior of No. 6.*

*Preliminary trials.* First trial. No. 6 was very active climbing all about the wire and running about on the floor. He caught the rope in his hands and later in his tail. He climbed the rope and in attempting to jump from the rope to the front of the cage he put his foot against the food door and the door opened. He did not notice it, however, and it was closed before he saw what he had done. He climbed the rope several times after and took no notice of the door.

Second trial. On the second day No. 6 was very active on the wire and the rope, but took no notice of the door.

Third trial. On the third day No. 6 behaved as usual, climbing about the wire. He took no notice of the rope.

Fourth trial. On the fourth day No. 6 climbed the wire several times, each time carrying the rope up in his tail. Later he climbed the rope, swung back and forth on it, and after two or three oscillations he leaped to the wire front. He took no notice of the food door.

Fifth trial. On the fifth day he grasped the rope and ran in a circle on the floor. Then he swung on the end of the rope twice. Then he grasped the rope in his tail three feet from the floor and allowed his body to swing. He dropped to the floor and caught flies. He climbed the rope and examined the cracks in the top of the cage. During his entire time in the cage he took no notice of the food door.

*Imitation tests.—No. 6 imitating No. 2.*—No. 6 was put into the observation-box and the box was put on the floor of the cage.

Performance 1. No. 2 spent the first few minutes on the floor of the cage, on the box, and in climbing the wire. He climbed the rope, but came down without any attention to the food door. No. 6 saw No. 2 on the rope.

No. 2 again climbed the rope and worked at the door slightly, but did not open it. No. 6 saw all the movements of No. 2. No. 2 then became frightened at No. 6 and did not work.

P. 2. No. 6 saw No. 2 with the food, but nothing more.

P. 3. No. 2 now became angry and pretended to fight, hanging over the box by his tail and shrieking loudly. No. 6 on the inside of the box jumped and threatened. No. 2 retreated to the corner by the rope and shrieked. Suddenly No. 6 stopped jumping, put his head on one side and purred. No. 2 had done this just before and now repeated it. His fear was gone; he shot up the rope, opened the door and got food. As No. 2 climbed the rope No. 6 looked out through the wire, and when he turned again toward No. 2 the latter was eating his banana. At once No. 6 began to jump up and down in his box to show his anger. No. 2 was again frightened and for several minutes the shrieking was renewed.

P. 4. At once No. 2 jumped to the rope from the front of the cage, but came to the floor without opening the door. He then walked about on the floor for several minutes. Then he climbed the rope, gave one push on the door, but failed to open it. He soon climbed again, opened the door and got food. No. 6 saw him with the food and threatened him; No. 2 shrieked; No. 6 folded his arms; No. 2 lay down on the floor. No. 6 jumped up and down; No. 2 came near the box, and seemed to have no fear.

P. 5. No. 2 climbed the rope, opened the door and got food. No. 6 saw all.

P. 6 to P. 8. No. 2 did as in P. 4. No. 6 saw No. 2 on the rope and at the door, but did not see him open the door.

No. 2 then sat on the floor quietly for several minutes.

P. 9. No. 2 climbed the rope and opened the door, but did not get the food which had dropped off the belt. The food was replaced and No. 2 got it. No. 6 saw all but the opening of the door.

No. 2 was now removed and No. 6 was released in the cage. At once he climbed the rope, put his hand against the door, but failed to open it. He then swung down, hanging by his tail to the rope, and dropped to the floor. He then climbed the rope and examined a hole in the top of the cage. He came to the floor again. Again he climbed the rope and examined all about the door; pushed on the door, but did not open it; he bit at the edge of the door and again pushed on it, opening it. He got the food and descended the rope, immediately afterward climbing the wire.

When the device was reset No. 6 climbed the rope and examined the door with his teeth and fingers; he worked at the edge with his fingers. He then jumped to the wire and in so doing put his foot against the door pushing it slightly; he leaped back at once and pushed the door open with his hand, getting the food.

When the device was reset No. 6 tried to open the door with his fingers and after one effort leaped to the wire. Leaping back he tried to bite the edge of the door and then by a vigorous push with his hand forced it open and got food. The device was reset and No. 6 climbed the rope at once. Placing his palm flat against the door he opened it with the first effort. He repeated the act as soon as the device was ready to operate, and four times more within a few minutes.

In all No. 6 opened the door and got food nine times within sixteen minutes.

#### *Summary of Behavior of No. 6 in the Rope Experiment.*

No. 6, like No. 4, was free on the rope from the first. He became indifferent to it during the later trials and made no progress toward getting food. When he was placed in the observation-box to watch No. 2 he was very attentive to what No. 2 did and seemed quite excited by the conduct of the latter. He saw the entire performance once and in part three times. When he was released his behavior was markedly different from what it had been in the preliminary trials. His attention was directed to the proper place to get the food, and after a few random movements he succeeded in getting food for himself in a manner similar to that which he had seen.

TABLE 12.  
No. 6 IMITATING No. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 6 saw.	Number of times No. 6 saw in part.	Result.	Time in minutes.
July 3 . . . . .	9	1	3	S	5

*E. Behavior of No. 5.*

*Preliminary trials.*—First trial. No. 5 as usual was very active. She climbed the wire side and end of the cage. She climbed the rope and thrust her arm through a hole in the top of the cage. She then hung to the rope at the top of the cage and tried to see through all the cracks in the top. She did not notice the door.

Second trial. On the second day No. 5 behaved as before, going all about the cage, on the wire, up the rope, etc., but did not observe the door.

Third trial. On the third day No. 5 showed no interest in the rope, but spent her time going about the cage.

Fourth trial. No. 5 climbed the wire; returning to the floor, she pushed on the door where she had entered. Once she grasped the rope in passing. Later she climbed the rope, but displayed no notice of the food door.

Fifth trial. On the fifth day No. 5 was active on the floor, on the wire and at the entering door. She grasped the rope in her tail several times; three times she climbed it, but took no notice of the food door.

*Imitation tests.*—No. 5 imitating No. 2.—First test. Both animals were free in the cage.

Performance 1. No. 5 did not see.

P. 2. No. 5 saw No. 2 get food and climbed the rope after him.

P. 3. No. 5 saw the getting of food, but did not see the push on the door.

P. 4. No. 5 saw the entire performance from the brace at X.

P. 5. No. 5 saw in part.

P. 6. No. 5 saw from the front and opposite the rope.

P. 7. No. 5 saw the entire performance and climbed the rope before the door was closed.

P. 8. No. 5 saw the entire performance.

When No. 2 was taken out No. 5 climbed the rope at once and put her hand on the door. She then became interested in the top of the cage. Three minutes later she climbed the rope and put her nose to the food door, but she did not push on it. Two minutes later she repeated this performance. Between the two performances and afterwards she went about the cage, climbed the wire and roamed about the floor for food. Apparently she was very hungry.

Second test. No. 5 was put into the observation-box, which was set on the floor of the cage.

Performance 1 to P. 4. No. 5 saw No. 2 push the door open with his hand in his usual way.

P. 5 to P. 7. No. 5 did not see.

P. 8. No. 5 saw No. 2 at the door with the food and tried to get out of her box. This frightened No. 2 and he became quiet.

P. 9. No. 5 did not see No. 2 until he jumped back to the wire with food.

P. 10. No. 5 saw perfectly.

No. 2 was taken out and No. 5 was released. She walked about the floor and made some efforts to push her hand through the wire to get a paper and to reach the belt. Then she climbed the rope, stopped when half way up to spat a fly, climbed to a small hole above the food door and tried to see out. Then she went down to the floor, walked about and climbed the wire. She jumped to the rope, but took no notice of the door. This she repeated later. Then she went to the floor, became quiet and curled up to sleep.

Third test. No. 5 was put into the observation-box on a level with the upper part of the rope and the food door.

Performance 1 to P. 3. She saw perfectly.

P. 4. No. 5 saw nothing.

P. 5. No. 5 saw perfectly and jumped at the side of the box as if to get food.

P. 6. No. 5 saw in part.

P. 7. No. 5 saw perfectly.

No. 2 was removed and No. 5 was released. She ran up the rope, but took no notice of the food door. She examined the top of the cage with the eye and hand and returned to the floor. She then climbed the rope and examined the food door with her eyes and hand, but did not push on it. She then climbed the wire from the floor and returned to the floor and looked about. She crouched near the door and slept, curled up in a characteristic fashion of her own.

Fourth test. No. 5 was again put into a box on a level with the food door. No. 2 was free in the cage. He got food sixteen times. Five of these performances No. 5 saw completely; five other times she saw in part.

No. 2 was removed and No. 5 was released. No. 5 at once climbed the rope, but a noise frightened her and she jumped to the wire front at once. Then she climbed about the wire and walked about the floor. Next she climbed the rope and looked and smelled about the food door. She returned to the floor and crouched in one corner. Then she lay down and slept.

Fifth test. No. 5 was put into a box on a level with the food door. No. 6 was used instead of No. 2.

At no time did she seem interested in No. 6. Her seeing was accidental and passive. At times when she saw No. 6 going up the rope or at the door she would turn away to look at the floor of her box. No. 5 saw five of fourteen performances completely; five other times she saw in part.

No. 6 was then taken out and No. 5 was released. She spent the entire ten minutes on the floor and in climbing the wire parts of the cage without once going to the rope. At the end of ten minutes she climbed the rope and looked at a crack in the cage door and at a hole in the top of the cage. She took no notice of the food door while on the rope.

She climbed up and down the wire and perched at the brace until she was removed.

Sixth test. Both animals were free in the cage.

Performance 1. No. 6 pushed the door open and got food. No. 5 saw and jumped to the rope from the front of the cage.

P. 2. No. 5 again saw from the front of the cage and jumped to the rope. She put her hand against the door, but did not push.

P. 3 to P. 6. No. 5 saw only in part, the eating of food.

P. 7. No. 5 saw perfectly and started up the rope; but when the food door was closed she came down.

P. 8. No. 5 saw and climbed to the food door, but did not push.

P. 9. No. 5 saw perfectly.

P. 10. No. 5 saw, climbed to the food door and looked through before it was closed.

P. 11. No. 5 saw and jumped to the rope while No. 6 was still getting food. Before the door could be closed she had her nose at the opening and was looking out. When it was closed she immediately pushed it open. In pushing she put her palm squarely against the door.

There was a marked difference between the behavior of No. 5 at this time and her previous conduct. Before, as noted, she had not been interested. Now she became interested and No. 6's movements directed her attention at once to the food door and kept it there almost all the time until she had learned.

After her first effort she could do the trick perfectly, and she repeated it six times within a few minutes.

TABLE 13.

## No. 5 IMITATING No. 2. No. 5 IMITATING No. 6.

Date.	Number of times No. 2 performed the act.	Number of times No. 5 saw.	Number of times No. 5 saw in part.	Result.	Time in minutes.
Aug. 10.....	8	5	2	F	10
Aug. 10.....	8	5	1	F	10
Aug. 10.....	7	5	1	F	10
Aug. 12.....	16	5	5	F	10
No. 5 IMITATING No. 6.					
Aug. 13.....	14	5	5	F	10
Aug. 13.....	11	7	4	S	While No. 6 was present.
Total.....	64	32	18	S	55

*Summary of Behavior of No. 5 in the Rope Experiment.*

Like No. 4 and No. 6, No. 5 had to learn to open the door only. In the first test her attention was directed to the door; she went to it, nosed about it and put her hand on the door. The second test did not add anything to her learning, but in the third test she repeated her behavior of the first test. The fifth test added nothing to her ability, but in the sixth, when she was free in the cage with No. 6, his conduct directed her attention to the food door and kept it there until she had learned to get food. At no time did she get food for herself in connection with the performance of No. 6, and the stimulus was never more than No. 6 performing an act and getting the result.

*General Summary of the Results of the Rope Experiment.*

Considering together the four animals used in the Rope Experiment we may note a similarity in the general behavior. First, no animal failed to learn. Second, in the preliminary trials there was a total indifference to the food door and either total or increasing inattention to the rope. Third, without exception, the first imitation test served to direct attention to the door and to the rope. In the case of No. 6, imitation was complete in the first test. Fourth, in the cases in which imitation was not complete in the first test, the successive tests augmented the imitator's attention and in no case were more than six tests needed to perfect the learning process.

Here, as in the chute experiments, we have attentive watching on the part of the imitating animals, followed by an abrupt and radical modification of behavior in the direction of the act observed. This is imitation as we have defined it.

TABLE 14.

## RESULTS OF THE ROPE EXPERIMENT.

## I.

Number of animals used.....	4
Cases of successful imitation .....	4
Cases of partially successful imitation.....	0
Cases of failure.....	0

## II.

Cases of imitation when the imitator was confined during the activity of the imitatee .....	2
Cases of imitation when the two animals were in the cage together.....	2

## III.

Cases of immediate imitation.....	1
Cases of gradual imitation.....	3

## IV.

Cases of imitation in which the imitating animal <i>did not</i> himself experience the result of the act before performing it.....	3
Cases of imitation in which the imitating animal <i>did</i> experience the result of the act before performing it.....	1

## 4. PAPER EXPERIMENT.

*A. Description of Device.*

For this experiment board *E* was used. An opening 17 cm. square was cut, the lower edge 30 cm. from the floor of the cage. The opening was covered on the outside by a hinge door. In the center of this door a hole 5 cm. in diameter was cut and on the outside of the door, just at the lower edge of the circular opening was fastened a food box. With the door open, a sheet of ordinary writing paper was laid over the opening and the door was then closed upon it. The hole in the door and the food in the box were thus hidden by the paper (fig. 6).

The animal could get food by breaking the paper and reaching through the circular hole. On the inside of board *E* was a wooden screen which, when dropped down, covered the whole device. When the paper and food were in place, and the animal or animals in the cage, this screen could be lifted by the experimenter by means of a string. When an animal had broken the paper, the screen was lowered by the experimenter and a new piece of paper was inserted. Then the screen was lifted and all was ready for a second test.

*B. Behavior of No. 2.*

On five different days, from April 6 to April 10, No. 2 was in the cage alone for thirty minutes each day. He did not get food from the box and made but little investigation of the paper. The most he did toward getting food was on April 7th, when he went to the paper, put his hands on the lower edge of the opening and bit at the paper, but did not tear it through.

On April 21, in order to help No. 2 to learn, the experimenter punched a hole in the paper with the point of a lead pencil and the monkey thrust one finger through and tore a larger hole. This was repeated a number of times and No. 2 learned to tear the paper by biting when no opening was made. On April 22 he got food in this way ten times in seven or eight minutes.

*C. Behavior of No. 3.*

*Preliminary trials.*—No. 3 was given four trials of thirty minutes each in the old cage in the Harvard Laboratory. In each of the first two trials

he went to the opening and put his hands on the lower edge of the frame. In the third and fourth trials No. 3 was wholly indifferent to the device, not going to it once.

He was given a fifth trial of fifteen minutes in the new cage at the New York Zoölogical Park. During this trial he went about the cage leisurely, but gave the paper no attention.

*Imitation tests.—No. 3 imitating No. 2.*—The two animals were in the cage together in each of the following tests.

First test. No. 2 tore the paper and got food, and No. 3 got some of the seeds which No. 2 dropped. No. 3 did not go to the paper. This was repeated twice; the third time No. 3 went to the paper and looked. The fourth and fifth times No. 3 did not see, but the sixth time he went to the paper before the screen was lifted and turned away as No. 2 tore the paper. The seventh time No. 3 got food through the hole after the paper had been torn by No. 2.

No. 2 was now taken out. No. 3 looked at the paper, but became interested in the other monkeys, who were chattering in the nearby cages. He paid no further attention to the paper during the fifteen minutes.

Second test. No. 2 tore a hole in the paper and stepped back. No. 3 went up, thrust his hand through and got food. No. 2 was now taken out for five minutes and No. 3 went to the paper and examined it. He did not bite or push. This he repeated four times.

Third test. No. 2 was now put back and immediately got food. No. 3 searched the box after him, but got nothing. When No. 2 opened it again No. 3 got food, but he failed the next time. No. 2 was now removed. No. 3 went to the place and bit at the paper, but not hard enough to break it through. This he repeated three times.

Fourth test. No. 2 opened the paper and No. 3 grabbed the torn paper and pulled it away. This was repeated twice and then, while No. 2 was eating, No. 3 went to the paper, put his nose against it and pushed. He did not, however, use his teeth. After No. 2 bit through the paper the next two times No. 3 used his hands to tear a larger opening.

When No. 2 was removed from the cage No. 3 went at once to the paper and bit through and got food. This he repeated four times, getting food the last time in ten seconds.

TABLE 15.  
No. 3 IMITATING No. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 3 saw.	Number of times No. 3 saw in part.	Result.	Time in minutes.
July 1.....	7	5		F	10
July 1.....	1	1		F	10
July 2.....	2	2		F	10
July 3.....	3	3		S	$\frac{1}{6}$
Total.....	13	11		S	30 $\frac{1}{6}$



*Summary of Behavior of No. 3 in the Paper Experiment.*

The case of No. 3 is a process of gradual imitation similar to that of No. 11 in Chute Experiment B and of No. 2, No. 4 and No. 5 in the Rope Experiment. The first test directed his attention to the paper and each test thereafter increased that attention and its attendant activity. During the tests he got food a number of times; finally, he repeated the act of No. 2 in the fourth test, after having seen No. 2 get food eleven times.

*D. Behavior of No. 10.*

*Preliminary trials.*—First trial, August 13. No. 10 at first was frightened, due to some disturbance in getting her into the cage. She went about the floor rapidly and up and down the wire as if looking for some way of escape. Once she went to the paper, examined the lower edge of the frame and climbed up on it. Going to the side of the cage, she reached through the wire and tried to pick up straws on the floor outside. She climbed the wire and returned to the floor at once. She now became very persistent in trying to get the straws on the outside, stopping in her efforts only to walk about the cage. She found a hole in the floor which had been used in a former test; she worked at this for a moment; then grasping the frame at the paper in both hands, she shook it vigorously. Then she returned to the straws again. Climbing to X, she perched for a moment and then went to the floor and examined the cracks in the floor and in the door. Then she climbed the wire and remained quiet during the remainder of the time.

Second trial, August 17. No. 10 was on the upper part of the wire end during the first eight minutes. Then she was driven to the floor, where she sat in the corner near the paper. Several times she climbed up on the frame about the paper. Then she sat with folded hands near it. Shortly she climbed the cage front. She went to the floor again and sat near the paper. She climbed the wire front and returned to the paper, surveying it with her eyes. She climbed upon the frame and then climbed the front of the cage. She returned to the floor and walked about.

Third trial, August 18. No. 10 went at once to the wire in her usual excited manner and remained near the top for two minutes. Then she came to the floor; she walked to the door and back to the end of the cage, climbing the wire end. This she repeated several times immediately and continued to repeat it during the next five minutes. From the upper part of the end she surveyed the floor and sides of the cage. She went to the floor and for a little time sat in the corner near the paper. Then she moved over and sat near the wire end. Then she mounted the wire end.

Fourth trial, August 19. Behavior as follows: Up wire end and looked about; around to the front of the cage; back to end and surveyed floor from upper part of it; around to the front and back to end; to floor and walked over to the door; about, looking through the wire and up the end; again to the floor and to the door, back to end and up; around to front and down to the door; glanced at the paper in passing; up the end and back and forth about the wire; to the floor and the door, about the floor; quite free

to go about the floor; put hand on frame near paper in passing; up end of cage.

Fifth trial, August 20. Behavior as follows: On floor and then turned to door which was still open; looked out intently; climbed the cage end; to the front and down to the floor; across to the end and down; around to front; down to the floor; to door and up the end of cage again; to floor and up end of the cage; to the floor; to the door; sat near wire end and climbed cage again. To the floor and to the door; sat near the paper; to door and back to wire end, sat on the floor and then climbed the cage.

Sixth trial, August 21. Behavior as follows: Up the end of the cage and remained for some time; to the front to catch a cockroach and back to the end; surveyed whole cage from end; around to front and down to the floor to look at the door; back up the end of cage; down again; about the floor and up the end of the cage; about the wire. No. 10 was given a sixth test because this was her first experience in the cage and in the earlier tests she had seem disturbed.

*Imitation tests.*—No. 10 imitating No. 11.—First test. No. 10 was in the observation-box on the floor of the cage. No. 11 was free in the cage. No. 10 was attentive to what No. 11 did.

P. 1 to P. 5. No. 10 saw perfectly.

No. 11 was then removed and No. 10 was released in the cage. Immediately she climbed the end to the top and looked back to the floor, to the door, and to the screen. She went to the front, still looking downward. She went to the floor, to the door, and looked at the paper. She turned and climbed the end of the cage again. She went to the front of the cage and looked down at the door and the paper. She went down as far as the brace and looked at the screen. Then she went to the floor, put her hands on the lower edge of the frame and looked at the paper carefully. She turned back to the end of the cage and climbed the wire. Again she went down to the brace and surveyed the floor. She went down to the door and then climbed the wire end again. She repeated this within one minute. She seemed more interested in escaping than in getting food. Again she went to the floor, looked about beneath the frame, and again climbed the end of the cage.

Second test. Conditions same as in previous test. No. 10 was very attentive to the movements of No. 11 and saw as follows:

P. 1 to P. 3. No. 10 saw perfectly.

She tried to get out of the observation-box and shook it vigorously.

P. 4. No. 10 saw perfectly and shook the box.

P. 5. No. 10 saw fairly well.

When No. 11 was released, she ran up the end of the cage. She went to the front and looked at the door and floor. She went to the floor and about to the door. She climbed the end of the cage and returned again to the floor; she went to the paper and put her left hand on upper part and pushed; then she put her right hand on the lower part and pushed. Then she climbed the end of the cage and held fast to wire with head turned back toward paper; she went slowly down to the floor and walked across to the paper; she put two hands up on lower edge of frame and bit a hole at

exactly the right place. She then put her hand in and got food. Time: two minutes.

She tore away all the paper and tried for some time to find more food. Failing in this she climbed the end of the cage again. She remained there until the device was reset. Then she looked around at it for some time. Finally, she went slowly around to the front, climbed down to the floor, tried to look through wire at animals in the living cages, stopped an instant at the door, went on to the paper and with feet on the lower edge of the frame bit a hole in the paper. She thrust her fingers into the hole and tore the paper all off, getting the food.

She then climbed the cage and waited until the device was reset. At once she went to the floor and across to the paper. She bit at it, but the paper did not break. Again she tried it with the same result. Then she tried to break it with her hand. She climbed the end of the cage and remained there a minute. Again she went to the floor and tried to bite through the paper, but failed as before. She walked about the floor and again returned to the paper. This time she bit at the edge of the hole and literally wore a hole in the paper by rubbing her teeth over the wood. When she had made a small hole, she poked one finger through the opening and by a very hard pull tore the heavy bond paper.

*Summary of Behavior of No. 10 in the Paper Experiment.*

In the preliminary trials No. 10 gave almost no attention to the paper, merely looking at it once and passing over it in climbing upon the frame which surrounded it. In the first test she watched No. 11 intently and when he was out of the cage, she manifested an increased interest in the paper. The second test increased this interest and she repeated exactly the behavior of No. 11 within two minutes after his removal.

TABLE 16.

NO. 10 IMITATING NO. 11.

Date.	Number of times No. 11 performed the act.	Number of times No. 10 saw.	Number of times No. 10 saw in part.	Result.	Time in minutes.
Aug. 23.....	5	5		F	12
Aug. 24.....	5	5		S	2
Total.....	10	10		S	14

*E. Behavior of No. 9.*

*Preliminary trials.*—First trial, July 2. No. 9 was active about the cage. He went to the paper and put his hands on the lower part of the frame. He repeated this soon again. Then he climbed the wire in front; then he

climbed upon the frame at the paper. He whined and called most of the time he was in the cage.

Second trial, July 3. No. 9 took no notice of the paper during the entire fifteen minutes he was in the cage. He climbed about the cage and tried to push the door open.

Third trial, July 4. No. 9 was very active about the cage, but paid no attention to the paper during the first minutes in the cage. Later he went to the paper, bit at the frame and climbed upon it.

Fourth trial, July 5. In the fifth trial No. 9 climbed about the cage and upon the screen frame about the paper. He made no effort to tear the paper.

Fifth trial, July 5. The behavior of No. 9 in the fifth trial was similar to what it was on the previous days. He gave no attention to the paper.

*Imitation tests.—No. 9 imitating No. 2.*—The two animals were in the cage together in each of the following tests.

First test. No. 9 was not at first inclined to be attentive to No. 2. It was not until No. 2 got food the fifth time that he apparently saw the act. Then he put his hands on the bottom of the screen frame and reached one hand through the hole, but he got no food. Several times before the device could be reset No. 9 went to the screen and bit it and climbed upon it. He had not been near the screen that day. During the sixth, seventh and eighth manipulations by No. 2, No. 9 was beside him and saw what was done. Each time he put his hand into the opening, but got no food; each time he climbed upon the lifted screen.

After No. 2 had been taken out No. 9 was quite active, running all about the cage. He went to the screen several times and bit at the edge of the frame. Once he pushed his hand up over the paper and at another time he bit at the inner edge of the frame next the paper.

Second test. No. 9 saw each time and was near No. 2 in the corner of the cage. During the third, fourth, and fifth performances No. 9's hands were on the lower edge of the frame and after the paper had been torn No. 9 got food along with No. 2.

When No. 2 had been taken out No. 9 went to the paper, climbed upon the frame and jumped to the wire. He returned to the paper and bit at the edge of the frame, but not at the paper. Several minutes later he went to the paper and put his nose to it. This he repeated three times. At the last time of the three, he sat on the bottom of the frame and tried the paper with his fingers. He finally tore it and got food at the end of fourteen minutes. When the device was reset No. 9 went to it and sat on the lower edge of the frame. He tried to tear the paper with his fingers, but failed to make a hole. He later went to it and bit at the edge of the frame, but not at the paper. A little later he examined the paper with his nose, but did not bite it.

Third test. No. 9 saw perfectly five times in six and got food twice. When alone he went to the paper, examined it with his nose, and went away. Later he went to the paper and fingered the edges. He then went away, returning once more during the fifteen minutes, but doing nothing.

Fourth test. This test was made forty-seven days after the preceding one. The conditions were the same as in the preceding test except that No. 6 was used instead of No. 2.

Performance 1. No. 9 saw and was just back of No. 6 when he tore the paper.

P. 2. No. 9 was on the back of No. 6, but his head was turned away. Because No. 9 insisted on riding on the cab back of No. 6, the latter was removed and No. 2 was substituted.

P. 3 to P. 7. No. 9 saw No. 2 at the paper from front wire and came down to it. He reached his hand in to get food, but No. 2 had taken it all.

When No. 2 was out No. 9 came down from the wire, climbed the screen frame, and sat on the edge. He jumped to the wire front, but at once returned to the corner by the paper and sat on the floor for some time looking at the paper and at that part of the cage. He then climbed the front of the cage. Twice he came to the floor, climbed the frame at the paper and jumped back to the wire front. After spending some time about the cage and on the floor, he climbed the screen frame and tried to bite the paper. He was too small to reach the hole from the floor and when he got upon the lower edge of the frame his body covered the place where he should bite the paper.

Fifth test. No. 9 and No. 2 were in the cage together. Since No. 9 was so small, a box was placed on the floor below the paper so that he could climb upon it and thus have a more nearly equal chance with the larger animals in exerting his force against the paper.

P. 1. No. 9 saw from the middle of floor.

P. 2. No. 9 saw in part.

P. 3. No. 9 saw from the wire front above the brace.

P. 4. No. 9 did not see the paper torn and did not come down for some time. He saw No. 2 eat the food, sitting on the box.

During each of the previous times he had searched the hole for food and got none. He now paid no attention to the place. No. 2 was allowed to continue eating food at the opening. No. 9 ran all about the cage, but paid no attention to No. 2 and the paper. Finally No. 9 went to the box and got sunflower seed and a piece of banana.

P. 5. No. 9 saw from the top of the wire front. He came down for food and No. 2 punished him; he ran up the cage crying.

P. 6 to P. 10. Did not see. Watching the experimenter.

P. 11 to P. 12. No. 9 saw from above X.

No. 2 was now removed. No. 9 ran up and down the wire and about the floor. Then he went to the box. He looked about for a moment and then pushed his hand over the upper part of the paper above the hole and around the upper edge of the paper. He looked at it and then climbed the wire and went about the cage.

After climbing about the cage, he came back to the paper, and put his hands against it. He did not get his hand over the opening, although he rubbed them about the paper considerably. He then played about the cage.

Sixth test. No. 9 was put into the observation-box and No. 6 was free in the cage.

P. 1 and P. 2. No. 9 saw in part.

P. 3 to P. 7. No. 9 saw the entire performance.

No. 6 was taken out and No. 9 was released. No. 9 ran up the wire, and came back to the floor and to the paper; he looked at it and climbed up on it. He then ran up the wire. Again he went to the paper and bit at the edge of it. Then he climbed up on it and jumped to the wire front. He repeated this performance twice. Then he ran all about the cage and came back to the screen. This he did repeatedly. He seemed more bent on getting out of the cage than on getting food. Several times he put his nose to the paper, but was not persistent about it, looking away at once. Later he bit the lower edge of the frame. Still later he bit at the frame next the edge of the paper.

Seventh test. The box was below the screen. No. 9 and No. 2 were free in the cage.

P. 1. No. 9 saw and got a sunflower seed through the opening.

P. 2. No. 9 did not see, although he sat near and must have heard the paper tear. He seemed indifferent to No. 2's getting food.

P. 3. No. 9 saw from post above X, but did not seem interested.

P. 4. No. 9 saw from upper part of wire end.

P. 5-P. 6. No. 9 saw from the wire above X.

P. 7. No. 9 saw from the wire above X, and going to floor got a grape skin No. 2 had dropped.

P. 8. No. 9 saw from wire above X. He went to the paper and put his hand in after No. 2 had left.

P. 9. No. 9 saw from above X. He went to the floor, put grape skin in his mouth, and went to the paper, where he put his hand in the hole. No. 2 jumped at him and struck him.

P. 10. No. 9 did not see.

P. 11. No. 9 saw from upper part of wire end; he got grape skin and went to the hole as before.

P. 12. No. 9 saw from wire above X.

No. 2 was taken out and No. 9 was left alone. He climbed the cage front at first. He came down to the box beneath paper, and looked all about the paper; climbed frame, jumped to front and ran to end of the cage. Again he went to box and looked all about the paper. He fingered the lower edge of the frame and then put his left hand flat against paper above the hole and pushed; he shoved palm over upper left-hand part of paper. Then he pushed his right hand over lower right-hand corner in the same way. Then he sat on the box and looked. After some time at box he climbed the wire to the upper part of the end. He soon went back to the box, where he sat before the paper and looked all about it. He climbed the frame, jumped to the front and ran up to the top of the wire end. He repeated this entire performance. He went to the box again, looked at the paper and the frame, and returned to the front and end of the cage.

*Summary of Behavior of No. 9 in the Paper Experiment.*

During the five preliminary trials No. 9 gave the paper no attention. The first test brought forth imitative behavior in that No. 9 put his hand through the hole to get food after seeing No. 2 get food. After the removal of No. 2, No. 9 pushed his hand up over the paper as if to tear it, a thing he had not done in the preliminary trials. The second test increased this attention and after repeated fingering at the paper he tore it off and got food. In the later tests he did not succeed in breaking through the paper, but he repeated the movements of No. 2 and gave persistent attention to the paper. His failure was possibly due not to the absence of the tendency to imitate, but to the lack of muscular power to exert sufficient strength to break the paper.

TABLE 17.

## NO. 9 IMITATING NO. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 9 saw.	Number of times No. 9 saw in part.	Result.	Time in minutes.
July 6.....	8	4	2	F	10
July 7.....	5	5		S	15
July 8.....	6	5		F	10

## NO. 9 IMITATING NO. 6.

Aug. 24.....	7	5	2	F	12
Aug. 24.....	4	2	1	F	10

## NO. 9 IMITATING NO. 2.

Aug. 24.....	8	3		F	10
Aug. 24.....	7	5	2	F	10
Aug. 25.....	12	10		F	15
Total.....	57	39	7	S	82

*General Summary of the Results of the Paper Experiment.*

That the problem set in the Paper Experiment was one easy of solution is evidenced by the fact that of eight animals all but three learned it alone, most of them in the first trial. Of the three animals which did not learn it alone two learned it by a process of gradual imitation. The other one was never more than partially successful, but his failure seemed due to a lack of physical strength rather than to a failure to repeat the act which he saw performed.

Here again, we note attention on the part of the observing animal and a subsequent marked change of behavior (somewhat sudden) in the direction of the behavior observed in the performing animal.

TABLE 18.

RESULTS OF THE PAPER EXPERIMENT.

I.

Number of animals used in imitation tests .....	3
Cases of successful imitation .....	2
Cases of partially successful imitation .....	1
Cases of failure to imitate .....	0

II.

Cases of imitation when the imitator was confined during the activity of the imitatee .....	1
Cases of imitation when the two animals were in the cage together .....	2

III.

Cases of immediate imitation .....	0
Cases of gradual imitation .....	3

IV.

Cases of imitation in which the imitating animal <i>did not</i> himself experience the result of the act before performing it .....	1
Cases in which the imitating animal <i>did</i> experience the result of the act before performing it .....	2

5. SCREEN EXPERIMENT.

*A. Description of Device.*

The device in this experiment was a modification of the one used in the Paper Experiment. The paper was not used. The string which lifted the screen (fig. 7, *a*) was removed.

The act which the animal had to perform was to push the screen up with one hand and with the other reach through the hole and get food. No animal was tried in this experiment which had not previously gotten food in the Paper Experiment.

*B. Behavior of No. 4.*

No. 4 first pushed the screen up when the paper was being adjusted in the Paper Experiment. She did not, however, tear the paper. The screen dropped back in place and she lifted it again. The fourth time she pushed the screen up, it stuck and did not drop back. She then tore the paper.



When the device was reset, No. 4 pushed the screen up and tore the paper. Thereafter, she lifted the screen and got food when she wanted to.

*C. Behavior of No. 6.*

*Preliminary trials.*—First trial. No. 6 was active, climbing up and down the wire, and upon the screen. He fingered about the edges of the screen, but made no effort to raise it.

Second trial. The second day No. 6 ran all about the cage, climbing the wire and upon the screen. He examined the screw eye where the string had been attached, but made no effort to lift the screen.

Third trial. On the third day he seemed interested in all parts of the cage, examining every crack and hole in it. He fingered the top of the screen as if to move it. Six times he climbed upon the screen. The remainder of the time he busied himself catching flies.

Fourth trial. On the fourth day No. 6 paid no attention to the screen during the fifteen minutes.

Fifth trial. No. 6 paid but little more attention to the screen on the fifth day. Three times he climbed upon it to jump to the wire front and three times he examined the hole above the screen.

*Imitation tests.*—*No. 6 imitating No. 4.*—The two animals were put into the cage together in each of the following tests.

First test. No. 6 was at first indifferent to the movements of No. 4. He usually saw No. 4 get the food, but failed to see him lift the screen. In the six times No. 4 lifted it in the test, No. 6 appeared to see twice. After No. 4 had been taken out, No. 6 paid no attention to the screen for ten minutes.

Second test. The first four times No. 4 lifted the screen No. 6 did not see. He was picking over the hulls left on the floor. The fifth time he saw from the opposite corner of the cage, and while No. 4 was up on the wire front eating, No. 6 went to the screen and looked. The sixth time the screen stuck when lifted, and No. 6 put his hand in and got food. After the seventh time No. 6 went to the screen and pushed on the lower edge of the frame. Then he pulled at the top and went away. He went back immediately and putting both hands on the screen pushed. He then went away, but when No. 4 lifted the screen he saw and went at once to it. Putting his hands on it he pushed it up one-third of the way. Then he pushed it up so as to reveal the hole, and got food. No. 4 pushed it up again and No. 6 saw. Immediately No. 6 lifted the screen and got food.

After No. 4 had been taken out No. 6 lifted the screen eight times in ten minutes. He could do it perfectly.

*Summary of Behavior of No. 6 in the Screen Experiment.*

No. 6 had seen the screen go up in the Paper Experiment and he had experienced getting food when the screen was lifted. However, his five preliminary trials in the Screen Experiment did not lead him to get food. When first in the cage with No. 4 he was not inclined to be attentive. When he saw No. 4 getting food in the second test he at once became inter-

ested in the screen. When once his attention was centered on the screen he very soon repeated the behavior of No. 4, not at first in a perfect way, but in his fifth effort he did it in exactly the way No. 4 had done the act in his presence.

TABLE 19.

## NO. 6 IMITATING NO. 4.

Date.	Number of times No. 4 performed the act.	Number of times No. 6 saw.	Number of times No. 6 saw in part.	Result.	Time in minutes.
July 6.....	6	2	4	F	10
July 7.....	11	6		S	12
Total.....	17	8	4	S	22

*D. Behavior of No. 5.*

*Preliminary trials.*—First trial. No. 5 examined the cage all over, but she manifested no particular interest in the screen. After ten minutes she looked it over slightly.

Second trial. On the second day she looked out through the wire, poked her fingers through the hole in the door, and then went to the screen and pulled at the screw eye. She was quite active, climbing about the cage rapidly. Once more she went to the screen, and then spent the remainder of the time catching flies.

Third trial. On the third day she bit at the screen frame and pulled at the screen during the first few minutes. She then spent the rest of her time as on the previous day.

Fourth trial. On the fourth day No. 5 showed more interest in the screen at first. She tried to shake the screen frame. Later she fingered the screen and bit at the frame.

Fifth trial. On the fifth day No. 5 bit at the screen frame several times and climbed upon it twice. Most of the time, however, she spent in other parts of the cage.

*Imitation tests.*—*No. 5 imitating No. 4 and No. 6.*—In all of the following tests the two animals were in the cage together.

First test. No. 5 was somewhat wary of No. 4 and did not come near. She saw No. 4 open the screen once in three times. When No. 4 was taken out No. 5 went to the screen and examined it, but she gave it no persistent attention. Later she fingered the lower edge of the screen.

Second test. No. 5 was attentive and saw the lifting of the screen five times.

When No. 4 was out No. 5 went at once to the screen and pulled at the top of it. She then ceased to be interested in it and examined other parts of the cage.

Third test. No. 5 was very hungry. She saw No. 4 open the screen once in the first three times. After the third trial, while No. 4 was up the wire front, eating, No. 5 went to the screen and examined it. She put her fingers into the cracks and climbed upon it to examine the top. The fifth and sixth times she saw plainly, and after each went to the screen and examined it. The seventh time No. 5 saw and hurried to the screen, but No. 4 let it drop and No. 5 turned away without trying to manipulate it. A little later she went to it. Again she saw and did as she had done after the seventh time. Then she turned back to the screen and examined it, thrusting a finger into the cracks about it.

When No. 4 was removed No. 5 manifested no interest in the screen, going to it but once and that at the end of fifteen minutes.

Fourth test. No. 5 climbed upon the screen after No. 4 lifted it the first time. She sat on the brace and saw No. 4 lift it the second time, but she did not go to the screen, nor did she at any time while No. 4 was in the cage.

When No. 5 was alone she went to the screen once during the ten minutes, but she touched no part of it.

Fifth test. No. 5 was somewhat afraid and did not go near the screen while No. 4 was present. She saw No. 4 from the side of the cage and from the floor five times.

When alone No. 5 went to the screen and climbed up on it once. The rest of the time she was indifferent to it.

Sixth test. No. 6 was now used instead of No. 4 on account of No. 5's fear. After the second time No. 5 saw she went to the screen and climbed upon it. She saw five times well.

When No. 6 was taken out No. 5 went to the screen, put her hands against it and pushed, but failed to lift it. She then gave up and paid no more attention to it.

Seventh test. No. 5 saw three times. After the third time she went to the screen and worked, but did not put her hands against it as she had done before. She did the same after seeing the fourth time. After the fifth performance No. 6 was removed.

No. 5 went to the screen and worked vigorously for fourteen minutes. She tried the top of the screen, the bottom of the screen and the frame repeatedly, pushing, pulling, and biting.

Eighth test. No. 5 was interested in the screen on first entering the cage and kept near for a time. She got food when she could; she worked at the screen usually after No. 6 let it down, but was not persistent about it. In all she saw ten times.

No. 6 was now taken out. No. 5 walked about the cage for a time trying to find food in the cracks. After four minutes she went to the screen and grasping it at the top shook it vigorously. She left it at once.

Ninth test. This test was immediately after the eighth. The moment No. 6 re-entered No. 5 became interested in the screen, but did not try to raise it. After the third lift she put one hand on the top of the screen and fingered the bottom with the other hand. She did the same after the fourth

lift. Each time when No. 6 raised the screen No. 5 went to it and looked, but she did not put her hands to the screen. She saw ten times.

When No. 6 went away No. 5 usually fingered and pulled the screen, but did not put her palm against it and push.

When No. 6 was out No. 5 lost interest in the screen and sat down in the corner of the cage.

Tenth test. No. 5 went to the screen on first entering the cage and worked at the lower edge of it and at the frame. No. 6 came and lifted the screen. No. 5 saw plainly and when No. 6 dropped some seeds No. 5 got them. This was repeated a number of times. No. 5 frequently went to the screen and worked while No. 6 was eating, but she never lifted it. She either grabbed the top and shook it or fingered the crack at the lower edge. She saw fifteen times in all.

When No. 6 was out No. 5 became indifferent to the screen and continued so during the entire ten minutes.

Eleventh test. No. 5 was near No. 6; she saw twenty times in thirty performances and often got the food which No. 6 dropped. After each performance No. 5 put her hands on the screen. She usually shook the top. A number of times when No. 6 was opening the screen No. 5 stood upright on her feet, with hands hanging loose and her nose close to the screen. She did not, however, put her hands on the screen while No. 6 was lifting it.

When No. 6 was out No. 5 manifested no more interest in the screen.

Twelfth test. No. 5 was attentive to No. 6 most of the time and saw at least fifteen times in twenty-six. After the third time No. 5 went to the screen and pushed on the frame with her palms; almost every time afterwards she went to the place when she saw No. 6 push the screen up. After the fifteenth time she went to the screen, placed her palms against it and looked all about the lower edge and pulled at the upper part. Once she got food when No. 6 pushed up the screen.

With No. 6 out No. 5 went to the screen and looked at it, but made no effort to get food. She remained quiet in the cage, and after eight minutes went to the screen and examined it with eyes and fingers.

Thirteenth test. No. 5 saw five of ten performances. When No. 6 had been taken out she made no effort to lift the screen.

#### *Summary of Behavior of No. 5 in the Screen Experiment.*

No. 5 had seen the screen lifted in the Paper Experiment and had gotten food by tearing the paper. During her preliminary trials in the Screen Experiment she manifested an interest in the screen, but this interest seemed to fade in the later trials. During the imitation tests, when she was observing No. 4, this interest increased and again died away. No. 6 was substituted for No. 4 and the interest of No. 5 again revived, reaching its highest point during these tests. In the sixth test she seemed nearest to repeating the act she had seen, when, after seeing No. 6 lift the screen five times, she went to the screen and in a manner similar to his put her hands against it and pushed. In the later tests, after failing in all her efforts at the

screen, No. 5 seemed interested in it only when No. 6 was present and working at it.

TABLE 20.

## No. 5 IMITATING No. 4 AND No. 6.

Date.	Number of times No. 4 performed the act.	Number of times No. 5 saw.	Number of times No. 5 saw in part.	Result.	Time in minutes.
July 6.....	3	1	2	F	10
July 6.....	5	5		F	10
July 7.....	7	5		F	10
July 8.....	5	5		F	10
July 9.....	7	5		F	10

## No. 5 IMITATING No. 6.

July 9.....	8	5		F	10
July 10.....	5	5		F	14
July 11.....	11	10		F	10
July 11.....	10	10		F	10
July 14.....	20	15		F	10
July 15.....	30	20		F	10
July 31.....	26	15	3	F	10
Aug. 2.....	10	5		F	10
Total.....	147	106	5	F	134

*E. Behavior of No. 2.*

*Preliminary trials.*—First trial. No. 2 was not active. He examined the screen with his nose and hands and bit at the screw eye in the top of it.

Second trial. On the second day No. 2 pushed the screen, but did not lift it; later he climbed upon it and examined the top of it. This he repeated twice.

Third trial. The third day's behavior was similar to that of the previous day. No. 2 pulled and gnawed at the screen and the screen frame. Part of the time he worked vigorously. Most of the time, however, he was in other parts of the cage.

Fourth trial. On the fourth day No. 2 was more vigorous than ever. He spent five minutes without intermission chewing at the bottom of the screen frame. He then quit and looked at a hole in the door. He made another brief examination of the top of the screen and went away. Several times he returned and examined the screen, once lifting one corner of it by pulling on the screw eye at the top.

Fifth trial. No. 2 was active at the screen, pulling at the top and biting the lower part of the frame. He made no progress, however.

*Imitation tests.*—No. 2 imitating No. 4.—During all of these tests No. 2 and No. 4 were together in the experiment cage.

First test. It was the first time No. 2 and No. 4 were together. They caressed at once and then No. 4 went to the screen. She lifted it five times and got food each time. No. 2 sat by her and seemed to see every movement, although his excitement may have kept his attention from centering on what she was doing. When No. 4 was removed No. 2 displayed no more than usual interest in the screen. He climbed to it, picked at it with his fingers and used it as a stand to climb up the post.

Second test. No. 2 was excited and was attentive to No. 4. He ate the apple crumbs which she dropped after the first opening. At the second and fifth opening he was "picking fleas," and did not see the screen go up.

While she was eating her fifth feed he went to the screen and examined it. The sixth and seventh times she lifted it, he saw perfectly. After the seventh he went to the screen and pushed against the lower edge of the frame and then bit at it where it joined the cage post.

After No. 4 had been taken out No. 2 began to work at the screen. He picked at the lower edge of the frame where it joined the post and then climbed upon the screen. He was too excited to work persistently, running to the side of the cage and starting at every noise. He worked intermittently for six minutes. Then when at the opposite side of the cage he started, ran to the screen and gave a single push upward on the lower edge of the frame. He then put both hands on the frame, but did not push. Because of his activity the period was prolonged to fifteen minutes.

Third test. No. 2 saw No. 4 the first time she got food and climbed the cage to get food from her. He saw the second time and got food from the hole while the screen stuck. When his food was gone No. 2 went to the screen and pulled at the top and pushed at the lower edge. He saw the third time, but became interested in picking fleas from No. 4 instead of getting food. The fourth and fifth times he saw perfectly.

After No. 4 had been taken out No. 2 ran about the cage, but paid no attention to the screen for the first four minutes. Then he worked at the lower edge of the screen a little.

Fourth test. After the third performance No. 2 went to the screen and touched it. After the fourth he went to it, put his hands against it and pushed, but he failed to lift it. Each of the five times he saw very well.

After No. 4 had been removed No. 2 went to the screen a number of times and put his hands on it. He also bit the lower part of the frame and climbed upon the screen.

Fifth test. No. 2 saw No. 4 well each time. He went to the screen after No. 4 had opened it and remained there while No. 4 ate her food. His efforts to get food were feeble.

After No. 4 had been taken out No. 2 climbed up on the screen a number of times, but in no case did he seem bent on getting the food.

Sixth test. No. 2 was interested in No. 4 and saw her get food each time in twenty. A few times he put his hands on the screen.

After No. 4 had been taken out No. 2 moved about the cage and worked but slightly at the screen.

Seventh test. No. 4 was very active and eager for food. No. 2 was fairly attentive, but No. 4 worked so rapidly No. 2 saw but twenty times in forty.

After No. 4 had been taken out No. 2 worked at the lower edge of the screen and at the frame. For ten minutes he kept persistently at the screen, biting and fingering the frame. Not once did he push against the screen to lift it.

Eighth test. No. 2 watched No. 4 at the outset very closely. After seeing her get food seven times he reached his hand to hers to get some food, but he was severely slapped. He made no effort to work at the screen while No. 4 was present.

After No. 4 had been taken out, No. 2 went to the screen and tried to manipulate it. He used his hands at the lower edge of the screen and bit at the screen frame. He kept at it most of the time during the ten minutes.

Ninth test. No. 2 was attentive to No. 4 at first, but when he failed to get food he became indifferent and looked at other things than No. 4. He kept near her, but at a safe distance.

After No. 4 had been removed No. 2 became interested in the screen at once. He fingered the crack at the lower edge, and bit at the frame. He was not persistent, however, and soon went to other parts of the cage. He returned later to the screen for a moment.

Tenth test. No. 2 was not inclined to watch No. 4, but spent his time in picking scraps from the floor. Once he went from the far part of the cage and pushed lightly against the lower edge of the frame with his hands.

After No. 4 had been taken out No. 2 spent his time on the floor. Once only he went to the screen; then he fingered the lower edge, but did nothing more.

TABLE 21.

No. 2 IMITATING No. 4.

Date.	Number of times No. 4 performed the act.	Number of times No. 2 saw.	Number of times No. 2 saw in part.	Result.	Time in minutes.
July 6.....	5	5		F	10
July 8.....	9	6	1	F	15
July 9.....	5	5		F	10
July 10.....	5	5		F	10
July 11.....	10	10		F	10
July 14.....	20	20		F	10
July 15.....	40	20		F	10
July 31.....	16	10	1	F	10
July 31.....	16	10	3	F	10
Aug. 1.....	35	10	4	F	10
Total.....	161	101	9	F	105

*Summary of Behavior of No. 2 in the Screen Experiment.*

As in the case of No. 5 and No. 6, No. 2 had gotten food in the Paper Experiment and had frequently seen the screen lifted. In his preliminary

trials he manifested an interest in the screen, but made no headway in getting food. In the imitation tests the conduct of the other animal seemed to accentuate his interest at times, but never sufficiently modified his behavior to enable him to get food. In the later tests he seemed interested in the screen only when another animal was present getting food.

*F. Behavior of No. 3 and No. 8.*

In the cases of No. 3 and No. 8 there was apparently but slight influence of the behavior of the imitator. Owing to the lack of space the details are omitted. The tables which follow show the number of tests to which they were subjected. The summaries give all that was important in their behavior.

*Summary of Behavior of No. 3 in the Screen Experiment.*

The behavior of No. 3 was much like that of No. 2. The imitation tests served to quicken his interest in the screen, but it waned even earlier in the series than that of No. 2. At the last, though he repeatedly got food when No. 4 did, he seemed interested in the screen only when No. 4 was working at it.

TABLE 22.

No. 3 IMITATING No. 4.

Date.	Number of times No. 4 performed the act.	Number of times No. 3 saw.	Number of times No. 3 saw in part.	Result.	Time in minutes.
July 6.....	5	5		F	10
July 8.....	8	8		F	10
July 9.....	7	5	1	F	10
July 10.....	5	5		F	14
July 11.....	12	10		F	10
July 14.....	14	10	2	F	10
July 15.....	43	20		F	10
July 31.....	20	10	4	F	10
Aug. 1.....	16	15	2	F	10
Aug. 1.....	18	12	3	F	10
Total.....	148	100	12	F	104

*Summary of Behavior of No. 8 in the Screen Experiment.*

The behavior of No. 8 practically repeated that of No. 3, though his activity evidenced even less influence of the behavior of No. 4. In the first imitation tests his attention to the screen increased slightly, but in the later tests it disappeared almost entirely.



TABLE 23.  
No. 8 IMITATING No. 4.

Date.	Number of times No. 4 performed the act.	Number of times No. 8 saw.	Number of times No. 8 saw in part.	Result.	Time in minutes.
July 6.....	5	1	4	F	10
July 8.....	8	5	1	F	10
July 9.....	5	5		F	10
July 10.....	6	6		F	10
July 11.....	14	10	1	F	10
July 11.....	13	8		F	10
July 14.....	15	12		F	10
July 15.....	25	20		F	10
Total.....	91	67	6	F	80

*General Summary of the Results of the Screen Experiment.*

In the Screen Experiment, but one animal in five learned to get food by seeing another animal get it. The behavior of the successful individual was a clear case of imitation. The behavior of the others agrees in that the first imitation tests show a decided increase of attention to the screen, and more or less effort to get the food. The same accentuation of attention occurred in the case of No. 5 when a new animal was used. These cases also agree in that the attention waned when the efforts to get food were unsuccessful, and that in the end the interest in the screen seemed dependent on the presence of an animal who could lift it. The behavior of No. 5 varied somewhat in that his interest in the screen persisted longer than did that of the other animals.

Although No. 6 was the only animal wholly successful in imitation, it is manifestly unfair to interpret the behavior of No. 5 or No. 2 as cases of total failure. Each of them did repeat, in part, the behavior of the imitator and this repetition seemed due to the action of the imitator. The fact is, that, if we arrange the behavior of the several animals in the order in which the results have been reported, we have a series of cases, in each member of which, the influence of the imitator shows less than in the preceding member. At the beginning, we have in No. 6, successful imitation. At the end, No. 8, who seemed stimulated only to look at the screen more

continuously. Between these extremes are the cases of No. 5, No. 2 and No. 3, which exhibit in a decreasing order the influence of the imitatee. One can well imagine that a large number of such cases would show quite a regular gradation in the complexity of the imitative behavior. In view of the evident gradations in the behavior of the animals I choose to call the cases of No. 5 and No. 2, partially successful imitation.

TABLE 24.

## RESULTS OF THE SCREEN EXPERIMENT.

I.	
Number of animals used in the imitation tests.....	5
Cases of successful imitation.....	1
Cases of partially successful imitation.....	2
Cases of failure to imitate.....	2
II.	
Cases of imitation when the imitator was confined during the activity of the imitatee.....	0
Cases of imitation when the two animals were in the cage together.....	3
III.	
Cases of immediate imitation.....	0
Cases of gradual imitation.....	3
IV.	
Cases of imitation in which the imitating animal <i>did not</i> himself experience the result of the act before performing it.....	0
Cases of imitation in which the imitating animal <i>did</i> experience the result of the act before performing it.....	3

## 6. PLUG EXPERIMENT.

A. *Description of Device.*

In board A, a hole 5 cm. square was cut, 35 cm. from the floor (fig. 8, *a*). Covering this hole on the outside of the cage was a slide door, made of glass, set in a wooden frame. Just outside of this glass door, food was exposed. The slide door could be opened by a string, *b*, which passed down under the cage, up the outside of the corner where the wire end met the wire side and through a hole, *c*, 90 cm. from the floor of the cage. The string was attached to the end of a plug, *d*, which fitted into this hole from the inside of the cage. The plug extended into the cage 4 cm. and was 1½ cm. in diameter.

To open the door the animal must climb the wire and pull out this plug (fig. 8). It could then get the food at the door (fig. 9). Conditions were such that when the monkey was looking at the door, his back was toward the plug, and that when he was working at the plug he could not see the door.

*B. Behavior of No. 5,*

*Preliminary trials*—First trial. No. 5 went at once to the plug and tried to bite it. She came down to the door and tried to get food. She went back at once to the plug and bit and pounded it. She pulled on it, but in such a manner that it bound on the edge of the opening and did not come out. She then went to the door again and looked at the food. A moment later she went to the plug and grabbed it in both hands. Then she went to door and struck at it with both hands in a characteristic manner. She tried to reach the string on the outside of the post. Failing in this she went back to the door. She went to the plug and pounded it with her nails. Then she jumped to the screw eye in the top of the cage where the rope had hung in the Rope Experiment. She held by the fingers of one hand and thrust the other arm through a hole (feeder hole) in the top of the cage. She then came down to the floor.

Second trial. On the second day No. 5 was still eager to solve the new problem, the slide door and the plug. She first climbed to the plug and chewed the end of it. Later she descended from the wire and after walking around on the floor went to the door and tapped on it with her nails. She then climbed to the plug and later went to the door. Then she went to the plug and chewed off some splinters. She tried to move it with her hands. Then she went back to the door, tapped it with her nails and later pushed it vigorously.

Third trial. On the third day No. 5 went to the door at once. A moment later she went to the plug. She pulled, bit and pounded it with her nails. She rushed down to the food door to get the food and worked at the door continuously for six minutes. She had several movements which she used repeatedly. She balanced on her feet in the middle of the cage, her body lifted slightly from the floor and almost erect; then she lunged at the door, striking it with both hands. Her aim was not direct enough to land on the glass, usually striking the edge of the opening. She sometimes jumped with such force as to throw her body back into the cage.

Another movement was to grasp the lower edge of the opening with both hands and shake it hard. She found a piece of paper on the floor and put it against the glass and pounded it and pushed on it. Then she tapped with her nails on the glass. Later she climbed the side of the cage near the door and supporting herself with her hands, she put her feet against the door and pushed. The next move was to force paper into the edges of the opening. Once, after vigorous effort, she ran up the post to the plug and pulled, bit and pounded it. The pull was always sideways, never straight out. This vigorous activity continued for twelve minutes. At the last she picked up some refuse, laid it upon the edge of the opening, and went away.

Fourth trial. On the fourth day No. 5 began to shake the door vigorously. She then rushed up to the plug and bit and pulled it. She worked at the slide door intermittently during the remainder of the time.

Fifth trial. The fifth day No. 5 went to the door and worked at the edge. She then climbed to the plug and bit and pulled. Then she ran down to the slide door. She returned to the door repeatedly. She worked persistently and vigorously at it, jumping at it and pounding it.

When No. 5 had failed in her five attempts the plug was pulled partly out of the hole. She was then able to pull it entirely out. She got the connection with the door at once and after a few times worked the device perfectly. She was then used to perform the act for others in the imitation tests.

#### *C. Behavior of No. 2.*

*Preliminary trials.*—First trial. No. 2 went to the door at once and looked at the food. He went soon again. He then spent the rest of the time about the cage in the usual manner.

Second trial. On the second day No. 2 climbed to the plug and bit it. He went to the floor and to the slide door. Later he bit the plug a number of times, but not persistently. He went to the door and fingered about the edges, and later pushed it with his hands a number of times.

Third trial. On the third trial No. 2 examined the door with his fingers and then took his leisure about the cage for the remainder of the time.

Fourth trial. On the fourth day No. 2 went to the door, but made no effort to get through to the food. He scratched on the glass and later pushed at it.

Fifth trial. On the fifth day No. 2 went to the door and then climbed the wire part of the cage. Later he went to *X* and bit at it. Still later he went to the door, but turned away. Two minutes later he returned to the door and pushed on it. He repeated this twice.

*Imitation tests.*—*No. 2 imitating No. 5.*—The two animals were put into the cage together in each of the following tests.

First test. No. 2 watched No. 5 most of the time, but did not often see exactly what No. 5 did. He saw five times in fifteen. Once he got food at the door.

With No. 5 out No. 2 worked rather persistently at the door for a few minutes. Then he climbed the post and bit the plug. Several times he came back to the plug and bit it.

Second test. No. 2 was very attentive and got a good view of No. 5. He saw her pull the plug five times in eight, and each time he saw her go from the string to the food.

When No. 5 was removed No. 2 saw the food at the door, but made no effort to get it.

Third test. No. 5 was very eager and pulled the plug repeatedly, getting the food as rapidly as it could be supplied. She pulled when the door was open as well as when it was closed. If the door was not closed after she had gotten food she pulled the plug, but after several pulls she ceased if the

door was not closed. No. 2 sat by and watched all the time. He saw the entire performance ten times.

When No. 5 was out No. 2 went to the door and fingered about it for three or four minutes. He then sat down and whined; he made no further effort to get the food. He did not notice the plug.

Fourth test. No. 2 and No. 5 were very friendly, No. 2 "picking fleas" from No. 5 when she was busy getting food. No. 5 was very eager to get food and rushed from the door to the plug. No. 2 was fairly attentive and saw No. 5 pull the string many times when she got no food. He saw her get the food ten times.

When No. 5 was out No. 2 worked at the door for some time. Then he climbed the post and pulled at the plug with his hands as No. 5 had done. He did not pull it out nor did he persist in pulling. Later he pulled the plug out, but did not see that it had opened the door. It was reset. Several minutes later he came to the plug, pulled it out, saw the door open, and got the food. When the door was reset he worked at it for three minutes, then climbed the cage wire and looked about. He was above the plug; he looked down, saw it, climbed down to it, pulled it out, saw the door open and got food. He pulled the plug again before it was reset. When it was reset he worked at the door for a minute, then climbed the cage, looked about and came back to the door. Then he ran up the plug, pulled it, and got food. He pulled it three times more before it could be reset. He repeated this four times in three minutes, getting food each time.

Three days later No. 2 pulled the plug twelve times within a few minutes, getting food each time.

TABLE 25.

## No. 2 IMITATING No. 5.

Date.	Number of times No. 5 performed the act.	Number of times No. 2 saw.	Number of times No. 2 saw in part.	Result.	Time in minutes.
July 13.....	15	5		F	10
July 13.....	8	5		F	10
July 14.....	20	10		F	10
July 15.....	25	10		S	20
Total.....	68	30		S	50

*Summary of Behavior of No. 2 in the Plug Experiment.*

The Plug Experiment set a different problem from any of the experiments already described. The food was obtained at one place, but the door could be opened only by working at a place removed from the door.

No. 2 made no progress toward a solution of the problem during his preliminary trials. The first three tests did not aid him. In the fourth test No. 5 made more rapid trips between the door and the plug. She seemed

quite excited. Probably her increased activity served as an increased stimulation to No. 2, for after her removal he gave more continuous attention to the door, and then went from the door to the plug and pulled. He repeatedly tried the plug and finally succeeded in pulling it out. After his first success, however, he did not go to the door, although he did after the next. The one experience, however, did not establish a perfect act, for when the device was reset he did not go at once to the plug, but worked at the door instead. He gave up trying to get the food and went about the cage. He went to the plug again only when his eyes accidentally (so it seemed) fell upon it. In the third experience there was apparent an element of accident, but after he got food the third time, he seemed to know the trick perfectly.

#### *D. Behavior of No. 6.*

*Preliminary trials.*—First trial. No. 6 climbed the cage and then went to the door and pushed at it. He examined all about it and then climbed the wire. He grasped the plug three times. Then he went back to the door six times and pushed it. Later he bit the plug.

Second trial. No. 6 was very playful. He leaped about the floor and up the wire. Once he went to the food door and later he went to the plug and bit it. He then went back to the floor and to the food door. He pushed at it and then played about the cage.

Third trial. No. 6 showed no interest in either the door or the plug.

Fourth trial. On the fourth day No. 6 was very active. He looked at the door and later perched at the plug, but he made no effort to pull it out.

Fifth trial. On the fifth day No. 6 went to the door and looked at the food. Then he ran about the cage. He was totally indifferent to the plug, and although he had been eager to get into the cage he was eager to leave it at the end of the period.

*Imitation tests.*—*No. 6 imitating No. 5.*—The two animals were in the cage together in each of the following tests.

First test. No. 6 soon discovered the food outside of the glass door and when No. 5 opened it No. 6 got the food. No. 5 punished him several times and No. 6 cried so much that his howling compelled his removal.

Second test. No. 6 was in the cage with No. 5 while she opened the door twenty times. He rarely saw—not more than five times in the twenty. No. 6 learned that the door opened and was inclined to sit in front of it. This turned his back to the plug and he did not see No. 5 pull it. Finally No. 5 drove him away from the door and he saw her pull the plug a few times.

When No. 5 was removed No. 6 went to the door and examined it. Then he ran up to the plug, bit at the end of it, and tried to pull it out. He ran down to the door at once. He climbed to the plug and worked at it with his hands. Several times he repeated this trip from the plug to the door and back to the plug.

Third test. No. 5 was very eager to get the food. No. 6 saw only occasionally—five times in fifteen.

When No. 5 was removed No. 6 gave his first attention to the door. Then he climbed to the plug, but did not work at it. He worked persistently at

the door. Finally he opened the door by working at it directly and got the food.

Fourth test. No. 5 was exceedingly active and after getting food would pull the string a number of times before the door was reset or the food replaced. No. 6 saw her ten times in fourteen.

When No. 5 was out No. 6 became very active about the door, working continuously to get the food. Once he ran up the wire and bit the plug.

Fifth test. At first No. 6 was quite indifferent to No. 5, but he became attentive as he saw No. 5 getting food. When No. 5 pulled the plug the eighth time No. 6 climbed the post and pulled it after her. As he pulled it he looked at the door. This he repeated after the ninth performance also, and again after the tenth.

When No. 5 was removed No. 6 went at once to the door; then he played up the wire and came down again to the door. Then he ran up to the plug and pulled it until he got the door open, two minutes after the removal of No. 5. When the apparatus was reset No. 6 began to work at the door. After one minute he climbed the cage, took one look through the wire, and went back to the door. Then in the midst of vigorous pushing at the door he suddenly stopped, fairly flew up the wire to the plug, and pulled it vigorously until it came out and the door opened. He came down quickly and got the food. He repeated this twice in two minutes. The next time the plug stuck, and although he worked at it vigorously, it was ten minutes before he succeeded in pulling it out. He had run about the cage somewhat during that time. He opened the door once afterward.

TABLE 26.

## No. 6 IMITATING No. 5.

Date.	Number of times No. 5 performed the act.	Number of times No. 6 saw.	Number of times No. 6 saw in part.	Result.	Time in minutes.
July 11.....	8		1	F	10
July 13.....	20	5		F	10
July 13.....	15	5		F	10
July 14.....	14	10		F	10
July 15.....	16	10		S	10
Total.....	73	30	1	S	50

*Summary of Behavior of No. 6 in the Plug Experiment.*

In his first preliminary trial No. 6 gave some attention to the food door and to the plug. His interest in the plug disappeared in the later trials. The second imitation test, which may be reckoned as the first, served to direct his interest to the plug. The third and fourth tests did not seem to increase this interest nor to make it productive of profitable results. The fifth test did show a decided increase of attention to the movements of No. 5, and,

finally, a repetition of those movements. The association between the door and the plug, however, did not seem perfect until after No. 6 had succeeded several times in pulling the plug and in getting food. The tendency of No. 6 was to center his attention on the door and, after failure there, to resort to the plug. This may have been due to the fact that he once got food by working directly at the door.

*General Summary of the Results of the Plug Experiment.*

In nicety of imitative behavior, the Plug Experiment furnishes less satisfactory results than do some of the other experiments. This is no doubt due in part to the fact that the food door and the means of its opening were in different parts of the cage. The two things could not well be within the range of vision at the same time. In transferring attention from the door to the plug the animal usually lost sight of the door. He did not see the imitator pull the plug and at the same time see the result of the pull. In case he saw the plug pulled, his eyes must follow the imitator back to the door in order to see the result. Despite this difficulty, the experiment yielded two cases of behavior in which the influence of the imitator was sufficient to guide the behavior of the observing animals to a successful issue. In the successful behavior there seemed to be an element of accident. It is impossible, however, to explain the conduct of either No. 6 or No. 2 as a case of random movement and accidental success, for prolonged opportunity to solve the problem in this way resulted in failure for each of them. Nor does it seem possible to think that No. 2 or No. 6 repeated the movements of No. 5 merely from seeing her perform the act and without connecting with her act the result which followed it. Each of the animals failed to pull the plug after seeing it pulled, until there had been abundant opportunity to see the performing animal get food.

TABLE 27.

RESULTS OF THE PLUG EXPERIMENT.

I.

Number of animals used in imitation tests.....	2
Cases of successful imitation.....	2
Cases of partially successful imitation.....	0
Cases of failure to imitate.....	0



## II.

Cases of imitation when the imitator was confined during the activity of the imitatee.....	0
Cases of imitation when the two animals were together in the cage.....	2

## III.

Cases of immediate imitation.....	0
Cases of gradual imitation.....	2

## IV.

Cases of imitation in which the imitating animal <i>did not</i> himself experience the result of the act before performing it.....	1
Cases of imitation in which the imitating animal <i>did</i> experience the result of the act before performing it.....	1

## 7. DUTTON EXPERIMENT.

*A. Description of Device.*

In this test the slide door (fig. 8, *a*) used in the Plug Experiment was the place where the animal could get food. It could be opened by a button (fig. 10, *b*) in board *D*, which must be pushed to the right. This button was 8 cm. broad at the largest breadth of its pear shape and 14 cm. long. Its lower edge was 22 cm. from the floor. A string, *c*, fastened to the back part of the button passed through a hole, 5 cm. in diameter, in board *D*, and along the outside of the cage to the slide door. The button was fastened to Board *D* at the top by a small bolt. A small knob fastened to the middle of the button enabled the animal to grasp it easily. A screw eye in the board prevented the button from being pushed to the left. The animal could get food by pushing the button to the right and then passing to the slide door in board *A* which had been opened by the movement of the button.

*B. Behavior of No. 3.*

*Preliminary trials.*—First trial. No. 3 worked at the door, biting the edges for ten minutes. He then walked to the button, gave one bite at it, and came back to the door. Later he repeated this, biting the knob on the button. He climbed the cage a number of times and then sat in the corner of the cage near the food door.

Second trial. On the second day No. 3 went to the door and bit at the edge, but not so vigorously on account of nails that had been driven into the edges of the opening to protect it. He went twice to the button and bit the edges. Then he ran about the cage, and finally rested in the corner near the food door.

Third trial. The third day No. 3 again worked at the food door, biting the edges. Then he went to the button, bit at it and came back to the door. He repeated this behavior four times in three minutes.

Fourth trial. On the fourth day No. 3 paid no attention to the door or to the button.

Fifth trial. On the fifth day he worked at the door for a short time. Then he climbed about the cage and ended the period by sitting in the corner near the button. Once he bit at the button.

*Imitation tests.—No. 3 imitating No. 2.*—Both animals were put into the cage together in each of the following tests.

First test. No. 3 was not attentive to No. 2 at first and was somewhat afraid. He saw four times fairly well. Several times the experimenter prevented No. 2 from opening the door because No. 3 was not watching.

When No. 2 was out No. 3 went to the door and worked vigorously for three minutes. He then went to the button, bit it and pulled as No. 2 had done. He came back to the door at once. Then he returned to the button, bit it, and came back to the door. Later he went to the button a number of times.

Second test. No. 3 was afraid and avoided the door and button while No. 2 was present. No. 2 was very active and opened the door much oftener than No. 3 saw. He saw five times in nineteen.

When No. 2 was out No. 3 worked at the door intermittently for several minutes, going once to the button and biting it.

Third test. No. 2 and No. 3 were on good terms and No. 3 kept near No. 2 and watched him most of the time. No. 2 worked very rapidly, but No. 3 saw him *well*, five times in ten.

When No. 2 was out No. 3 worked at the door for a little time, and then went to the button and pulled it back with his teeth. This movement was different from his previous acts at the button, which were mere bites with no effort to pull. He looked out at the opening behind the button and then went to the door and got food. Time: two minutes after the removal of No. 2. He repeated the entire performance within one minute and six times more within ten minutes.

TABLE 28.

## No. 3 IMITATING No. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 4 saw.	Number of times No. 4 saw in part.	Result.	Time in minutes.
July 27.....	9	4	2	F	10
July 27.....	19	5	4	F	10
July 28.....	10	5	3	S	10
Total.....	38	14	9	S	30

*Summary of Behavior of No. 3 in the Button Experiment.*

At first No. 3 manifested an interest in the door and in the button, but this interest waned as the preliminary trials were continued, and seemed

entirely gone in the fourth and fifth. It received a decided accentuation in the first test, after No. 3 had seen No. 2 get food four times. In the second test it seemed about the same, but in the third test it led No. 3 to repeat in detail the movements of No. 2 and to secure the same result.

*C. Behavior of No. 4.*

*Preliminary trials.*—First test. After four minutes in the cage No. 4 went to the button, put both hands on it, bit at the knob and bottom of the button and turned away. She spent the remainder of the time on the floor of the cage and on the wire. She returned to the door a number of times, but made but little effort to get food.

Second trial. On the second day No. 4 went to the door frequently and occasionally to the button, but she made no effort to manipulate either. She was anxious to get out of the cage.

Third trial. On the third day No. 4 went to the door, but made no effort to get food. Later she smelled at the button, but made no effort to move it.

Fourth trial. On the fourth day No. 4 paid no attention to either the door or the button.

Fifth trial. On the fifth day the behavior of No. 4 was as usual. She bit at the button once or twice in passing and went to the door twice.

*Imitation tests.*—*No. 4 imitating No. 2.*—In each of the following tests both animals were in the cage together.

First test. No. 4 at first was not inclined to notice No. 2. She saw five times in twenty-three. No. 2 was frequently prevented from opening the door until No. 4 was looking. She often saw the door open, but paid no attention to the button or to No. 2. When finally she saw No. 2 push the button, she went immediately and did the same thing. She did it three times more while No. 2 was present.

When No. 2 was out No. 4 worked two minutes at the door and then walked over to the button and pushed it back. This disclosed the opening behind the button and she thrust her hand out. She withdrew it immediately and came back to the door and got food. When the apparatus was reset she went to the button immediately; pushed it back, thrust her hand out and came at once to the door and got food. She repeated this four times. Then she ceased to thrust her hand out, and came immediately to the opened door. Within five minutes she had gotten food ten times.

*Summary of Behavior of No. 4 in the Button Experiment.*

The behavior of No. 4 was decidedly changed by seeing No. 2 push back the button. For five days, fifteen minutes per day, she had had the opportunity to get the food by pushing the button, but had not done so. Yet she pushed the button within five seconds after seeing No. 2 do it. There is no evidence as to whether she connected the button with the food at the time. The directness with which she later went from the door to the button, pushed it back and came back to the door to get food would indicate that she had made the connection. That the association was complete after the

second experience is evidenced by the directness and rapidity with which she continued to perform the act.

TABLE 29.

## No. 4 IMITATING No. 2.

Date.	Number of times No. 2 performed the act.	Number of times No. 4 saw.	Number of times No. 4 saw in part.	Result.	Time in minutes.
July 27 . . . . .	23	5	3	S	10

*D. Behavior of No. 5.*

*Preliminary trials.*—First trial. No. 5 worked at the door; then she climbed the cage and came back to the door. She went to the button and spat it with both hands. Later she bit at the screw eye, held the button, and bit it. She then turned and pushed it with her feet. Later she grabbed the screw eye in her hand and bit it. After twelve minutes she placed herself opposite the door and plunged against it twice with great force. She went to the button, and, placing herself opposite it, plunged against it twice in the same manner. Then she went to the door and looked. She then plunged against the button and spat it several times; she went once to the door and looked. Later she bit again at the screw eye; she then went from the door to the button and back to the door.

Second trial. On the second day No. 5 worked at the door for the first four minutes. She then went to the button and spat it. Later she hooked her tail in the wire about three feet above the door, placed her feet on the board A, and, with head down, she lifted her body out from the board and threw her weight on her hands against the door.

Third trial. On the third day No. 5 went to the door, climbed the cage, and after several minutes went to the button and spat it. During the remainder of the time she went about the cage in the usual way, paying no attention to the door or the button.

Fourth trial. On the fourth day No. 5 went to the door once. Once she went to the button and taking the screw eye in the left hand spat the button with the right. She gave no further attention to door or button.

Fifth trial. On the fifth day No. 5 went about the cage mostly indifferent to the door and button. Once she spat the button and bit it. She spent a little time at the door when she was first placed in the cage.

*Imitation tests.*—No. 5 imitating No. 2 and No. 4.—The animals were in the cage together in each of the following tests.

First test. No. 5 watched No. 2 closely and saw the entire performance five times in ten. The first time she saw No. 2 push the button she followed and pushed it back herself. She did not follow to the food. She did this three times on seeing No. 2 do it and usually missed seeing him get food.

When No. 2 was out No. 5 worked vigorously at the door and then went to the button and pulled at the screw eye and the knob, but not in such a way as to open it. Three times she went to the button and back to the door.

Second test. No. 5 saw No. 2 push the button five times in thirteen, but did not follow him to the food door.

After No. 2 had been taken out No. 5 became quite eager about the door for a minute. She went to the button, but made no effort to move it.

Third test. No. 4 was used instead of No. 2. No. 5 saw No. 4 five times in fifteen. She did not follow her about, but kept out of her way.

When No. 4 was removed No. 5 worked a little while at the door and then played about the cage for ten minutes.

Fourth test. No. 5 was afraid of No. 4 and kept away from her, owing to the punishment No. 4 had given her. She kept close watch on No. 4, however, and saw her move the button back and get food. This she saw ten times in nineteen.

With No. 4 out No. 5 looked through the door at the food, but did not work vigorously. She took her leisure about the cage for ten minutes.

Fifth test. No. 2 was again used. No. 2 pushed the button and No. 5 followed and pushed it, and coming to the door got food. No. 5 retreated to the front of the cage and kept her eyes on No. 2. Each time when No. 2 pushed the button No. 5 came to the door for food. She thus prevented him from getting any, for he was afraid of her. Once (fifth trial) she got food, and immediately went to the button and pushed it back.

No. 5 became much more attentive to No. 2 than at any time previously and her eyes flashed from the door to No. 2 and from No. 2 to the door, and always when he pushed the button she came to the door. After seeing him three times more she went to the button again, pushed it back and went directly to the door for food. This she repeated three times, the first two times coming directly to the door, and the third stopping for a moment to examine the opening behind the button. This she repeated once and then performed the entire act six times, not stopping to make any examination of the button.

*Summary of Behavior of No. 5 in the Button Experiment.*

Despite her unusual and persistent activity No. 5 did not once push the button during her preliminary trials. Yet she did push it at once after seeing No. 2 do it. Three times she repeated this, but not once did she go to the food door after doing so. What she had learned seemed to avail her nothing until the fifth test. She then followed No. 2 through his entire act of pushing the button and coming to the door to get food. She maintained a heightened interest in No. 2 during the whole of his ten performances, and by the end of the time was able to get food for herself as she had seen him do it. It should be noted that after pushing the button back and securing no result she ceased to push it during the second, third and fourth tests. Where this conduct reappeared it was connected with the getting of the food.

TABLE 30.

## No. 5 IMITATING No. 2 AND No. 4.

Date.	Number of times No. 2 and No. 4 performed the act.	Number of times No. 5 saw.	Number of times No. 5 saw in part.	Result.	Time in minutes.
July 27.....	10	5		F	10
July 28.....	13	5	4	F	10
No. 5 IMITATING No. 4.					
July 28.....	15	5	3	F	10
July 29.....	19	10		F	10
No. 5 IMITATING No. 2.					
July 30.....	10	10		S	While No. 2 was present.
Total.....	67	35	7	S	

*E. Behavior of No. 6.*

*Preliminary trials.*—First trial. No. 6 was very frantic about the food door. He rushed to where the plug had been in the Plug Experiment and worked at the hole in the post. He looked at the button and put his hands on it, but made no effort to move it. Later he bit at it. He then gave up his efforts.

Second trial. On the second day No. 6 tried the door as before, but on account of nails which had been driven in the edge he could not bite it. Once he went to the button and put his hands on it, and ten minutes later bit at it in passing.

Third trial. The third day there was the usual behavior about the cage. No. 6 worked at the door for several minutes and once pulled at the screw eye. Then he took his leisure about the cage.

Fourth trial. On the fourth day No. 6 was very active at the door, biting and pushing it. Once he grabbed the screw eye in passing. He then played about the cage, going to the door frequently, but not working at it.

Fifth trial. On the fifth day No. 6 tried the door a few times, but not vigorously as on previous days. He bit at the button in passing.

*Imitation tests.*—*No. 6 imitating No. 4.*—Both animals were in the cage together in each of the following tests.

First test. After the first few minutes No. 6 became afraid of No. 4 and kept away from her. In fifty-five performances No. 6 saw only three times. The first time he saw No. 4 move the button, he followed and did the same thing himself, but did not follow No. 4 to the door. When No. 4 was removed No. 6 went at once to the food door and worked incessantly and with great vigor for five minutes. Once during the time he went to the

button and bit it. He did not come back to the door and he went to many other places in the cage as well as to the button. At other times, when near it he paid no attention to the button.

Second test. No. 6 was not so frightened as in the previous test and remained on the floor near No. 4 five times in nineteen. He saw her push the button and get food. The second and fourth times he saw No. 4 push the button he went to it and looked out at the opening.

When No. 4 was out No. 6 became very active with his teeth and hands at the door. After nine minutes he went to the button and pushed it with his hands, but as the push was directly toward the board, and not to one side, as was necessary to open the door, he did not succeed. Later he put his hand on the screw eye.

Third test. No. 6 watched more attentively than in the first test and saw five times in twenty-seven.

When No. 4 was removed No. 6 worked incessantly at the food door with his hands, feet, and teeth. He used his tail to thrust through the wire when he could not reach around with his hand. Once he thrust his tail around the corner of the cage and caught the string to which the banana was attached. He was not allowed to get food in this way. He paid no attention to the button during the time.

Fourth test. No. 6 was more attentive than on any previous day and saw five times in eleven. After seeing the fourth time he went to the button and pushed with his hand, but not in such a way as to open the door. After the fifth time he bit at the lower edge of the button.

After No. 4 was out No. 6 did not go to the button. He worked more or less intermittently at the door for ten minutes.

Fifth test. No. 4 worked slowly and gave No. 6 a good opportunity to see, but he was not attentive and saw only seven times in forty-one. Then his look was not direct. The first time he saw, he went to the button and looked through the hole behind it.

When No. 5 was out No. 6 got food by fingering at the door. Then he worked at the door and once bit the button, but he was not at all active.

Sixth test. No. 6 kept his attention on the door during thirty-two performances, but rarely turned his attention to the button even though No. 4 went from the door to the button and back to the door for food repeatedly. His attention was almost wholly on the door. Ten times in the thirty-two he saw No. 4 push the button.

When No. 4 was out No. 6 became very eager at the door and continued so for ten minutes, but did not once go to the button.

Seventh test. No. 6 was quite indifferent to all the movements of No. 4. He often looked at the door as No. 4 left it to go to the button. It was not clear whether No. 4's leaving the door suggested that the door was about to open, or whether No. 6 was all the time interested in the door and showed his interest only when No. 4 left the way clear. He saw five times in thirty-five and then only by glances.

When No. 4 was out No. 6 became at once interested in the door and worked at it most of the time for five minutes. Then he ran about the cage, but paid no attention to the button.

Eighth test. No. 5 was used instead of No. 4. No. 6 was not at all attentive to No. 5. At times he watched the door when No. 5 went to the button. He was not afraid of No. 5, so did not run away. No. 5 worked rapidly and moved the button with wide movements of her arms. No. 6, however, showed no interest in the button.

When No. 5 was out No. 6 paid no attention to the button and but little to the door.

Ninth test. No. 6 was very indifferent to the movements of No. 5 except at the door. He often saw No. 5 get the food at the door and twice got food there himself. The movement of No. 5 from the door to the button and back to the door apparently meant nothing to him.

When alone No. 6 worked intermittently at the door for ten minutes, but did not notice the button.

Tenth test. No. 6 saw five times in the twelve that No. 5 opened the door.

When No. 5 was removed No. 6 became busy at the door, but paid no attention to the button during ten minutes.

*Summary of Behavior of No. 6 in the Button Experiment.*

What No. 6 saw in the Button Experiment seemed to profit him nothing. Once he repeated the movement of No. 4 in pushing back the button, but he did not at that time nor later connect the button with the food door. At no time did he give good attention to what was done in his presence, in the ten tests seeing only fifty-one out of three hundred and three performances.

TABLE 31.

NO. 6 IMITATING NO. 4 AND NO. 5.

Date.	Number of times No. 4 and No. 5 performed the act.	Number of times No. 6 saw.	Number of times No. 6 saw in part.	Result.	Time in minutes.
July 27.....	55	3	2	F	10
July 28.....	19	5		F	10
July 28.....	27	5		F	10
July 29.....	11	5	3	F	10
July 29.....	41	7		F	10
July 30.....	32	10		F	10
July 30.....	35	5		F	10

NO. 6 IMITATING NO. 5.

July 30.....	50	3		F	10
Aug. 2.....	21	3	10	F	10
Aug. 13.....	12	5		F	10
Total.....	303	51	15	F	100



*General Summary of the Results of the Button Experiment.*

Taken as a whole the Button Experiment gives three cases of imitation, no one of them immediately successful in detail. In the cases of No. 4, No. 5 and No. 3, there was an immediate modification of behavior, but in no case was there an exact repetition of the behavior of the performing animal. It did not require many repetitions of the act, however, for each animal to learn to perform the act perfectly.

TABLE 32.

## RESULTS OF THE BUTTON EXPERIMENT.

I.	
Number of animals used in imitation tests.....	4
Cases of successful imitation.....	3
Cases of partially successful imitation.....	0
Cases of failure to imitate.....	1
II.	
Cases of imitation when the imitator was confined during the activity of the imitatee.....	0
Cases of imitation when the two animals were together in the cage.....	3
III.	
Cases of immediate imitation.....	0
Cases of gradual imitation.....	3
IV.	
Cases of imitation in which the imitating animal <i>did not</i> himself experience the result of the act before performing it.....	3
Cases of imitation in which the imitating animal <i>did</i> experience the result of the act before performing it.....	0

## 8. STRING EXPERIMENT.

*A. Description of Device.*

From the top of the experiment cage (fig. 11) strings 1, 5, 6, and 7 were dropped downward along each of the corner posts to within 18 cm. of the floor of the cage. Along the back of the cage and 15 cm. apart were suspended three other strings, 2, 3, and 4, in like manner. To the lower end of each string was fastened a small knob, *k*. In the following observations on the behavior of the animals *2t* indicates the second string at the place where it enters the cage, and *2k* indicates the knob attached to the end of the second string.

In the lower part of board *B*, 6 cm. from the floor, was a circular opening, *L*, 5 cm. in diameter. On the outside of the board was a square chute (fig. 12, *a*), the bottom of which, *b*, was level with the bottom of the circular opening, *L*. In the chute, a little way above the opening, was a trap door, *c*, which could be opened by a lever, *d*, to which could be fastened any one of the seven strings above described. In this experiment, string 2 was so attached. By pulling this string the animal on the inside of the cage could open the trap door in the chute and thus cause the food on the door to fall to the bottom of the chute or roll out into the cage through the opening in board *B*. In either case the monkey could get it.

*B. Behavior of No. 13.*

*Preliminary trials.*—First trial, August 14. When No. 13 entered the cage he went at once to *L* and looked at the opening. He then went to *6k* and, taking it in his hand, bit it, dropping it after the first bite. Recrossing to *1k* he did the same thing, immediately afterward climbing the wire end of the cage. Returning to the floor he went to 5 and to *L*, thence crossing the floor to 6, biting *6k* and recrossing to *2k* and biting it. He then moved about as follows: up the wire; around to 6; back to 1; on the wire; to the floor; to *2k* and bit; thrust his hand into *L*; to *5k* and bit; to *4k* and bit; to the small door and pushed; to *7k* and bit; to 2 and started to climb, but turned his attention to 1 and 3; thrust his hand into *L*; to the door and to 5; across to 7 and up the wire to *X*. The time for the above described behavior was four minutes.

He then continued as follows: perched at *X*; to the floor; to the door and chewed the edges; up to *X* and perched; to the floor; thrust hand into *L*; up to *X*, perched and played with 7; to 1; back to 7 and to the floor; to 6 and looked at it; around to *L* and looked; on around to 7 and up to *X*; to the floor; to 5; up to the top of the cage and examined the hole in the top; to the floor; to 4 and to 7; up to *X*; to the floor, the door, and back to *X*; pulled 7 up to him; about the wire front; to the floor and about the floor to *3k*, which he took in his hand; up to *X*; to the floor; to the door and carried *6k* up to *X*; to the floor and to *2k*; carried *2k* in his hand up to *X* and looked it over; then to the floor and around the cage to 5, 4, 3, and 2 in succession. He gave a jerk at 2 and dropped it.

Second trial, August 15. No. 13 was active as on the previous day, but spent more time in looking and less in running about. He first ran up and down the wire several times; then he went to *L* and looked in. His later movements were as follows: up the wire; to the floor; to the door and bit at the edges; to *L* and looked; up the wire to the brace and back to the floor; to the corner post at *5k* and bit the post; up the wire and bit at it; down to the floor and again up the wire on the front of the cage; perched at *X* for some time and then went to the floor and bit *1k*; carried *1k* up to *X* and worked with it; bit the knob and the end of the string; pulled *7k* up to *X* and chewed it; then went to the floor and walked about; carried *1k* up the side of the cage; after some time returned to the floor, bit at *5k*; carried *2k* up the wire to *X* and farther up the wire.

In none of his movements did he display the same eagerness and expectation as in the previous trial.

Third trial, August 17. On this day No. 13 was even less active than on the second day. He went up the wire to the brace and returned to the floor, going to the door, pushing on it and passing around to *L*. He then carried *2k* up to *X* and bit at the string, dropping it almost immediately. Then he climbed the wire, but returned to *X*, where he perched and remained for some time looking about the cage. Later he went to the floor and examined all around the edge of the floor, but soon returned to *X*, where he remained for some time again. Twice later he climbed the wire to the top, but spent all the rest of his time at *X*, looking about the inside of the cage and out through the wire.

Fourth trial, August 18. The behavior of No. 13 was about the same as in the preceding trial; he climbed to *X* and returned to the floor; he touched *5k* and *4k*; then he carried *2k* up to *X* and bit at the string, dropping it after a moment. For several minutes he sat at *X*. Then he drew *7k* up to him and worked at it for some time. At first he worked directly at the knot and made some progress toward untying it. Then, as if discouraged, he began biting and pulling the protruding end of the string. At the end of several minutes' continuous work he dropped *7k* and went to the floor, tried to climb the post at 5 and passed on to *2k*, which he carried up to *X*, where he chewed at the knot in the string. After a moment he let it drop and swing back to its place. Two minutes later he went to the floor and to *L*, at which he looked intently. Climbing the wire to *X*, he perched for the remaining few minutes he was in the cage.

Fifth trial, August 19. No. 13's behavior was about the same as on the previous day. He climbed up and down the wire several times and examined around the edge of the floor. Carrying *2k* up to *X*, he bit at the knot once and dropped it. Then he played up and down the wire, and going to the door tried to open it, afterwards carrying *6k* up to *X*, biting it and dropping it when he climbed higher up the wire. He climbed to the upper part of the wire and chewed at the edges of the cage frame, but quit when spoken to. Again he carried *6k* up the side and end of the cage, dropped it, and settled at *X* for several minutes. Later he went to the floor, to *L*, to the door and carried *6k* up to *X*. He dropped it at once and remained quiet. Once again he went to the floor and carried *2k* up to *X*, where he chewed the string and licked the knob.

*Imitation tests.—No. 13 imitating No. 5.*—First test. No. 13 was put into the observation-box and the box was placed on the floor of the experiment cage exactly in front of *L*. This position enabled No. 13 to see all the movements of No. 5 in getting food. No. 5 was free in the cage. The two animals had never been together before and No. 5 was much frightened. Instead of working at getting food she crouched in the corners of the cage and occasionally dashed at No. 13 as if to frighten him. Once No. 5 ran up the wire end and leaning over to *2t* pulled it with her teeth. No. 13 did not see the pull, but he saw No. 5 leaning over to the place. He became demonstrative, and No. 5 did nothing but crouch for several minutes. The observation-box

was then moved farther away from *L*, and No. 5 went to *L* and got food. No. 13 saw her get it. He was very impatient and tried repeatedly to get out of the box, working at the door and shaking the box vigorously. No. 5 again waited and after some time went cautiously to *2k*; she took it in her hand, but did not pull with sufficient strength to drop the food. No. 13 saw her do this. For some time No. 5 refused to work on the floor, but she attempted to get to *2t* several times. This she was prevented from doing. Finally she became accustomed to the presence of No. 13 and moved about the floor freely. She then became very eager to get food. Within a few minutes she had operated the mechanism seven times. The record for No. 13 was as follows:

Performance 1. No. 13 saw well.

P. 2, P. 5, and P. 6. No. 13 did not see.

P. 3, P. 4, and P. 7. No. 13 saw and was eager to get out of his box.

If we count the times No. 5 pulled the string, but did not get food, No. 13 saw the performance five times, four of which he saw entire and one in part.

No. 5 was now removed from the cage and No. 13 was released. At once he climbed the end of the cage to *2t* and taking it in his teeth, he pulled it several times. Then he went to the floor and walked about; after some time he went to *L* and got the food that had dropped when he pulled *2t*. When the food had been eaten he climbed to *2t* and pulled the string with his teeth. The dropping of the food made a noise, but No. 13 did not notice it. After several more pulls he went down to *X* and sat there for a short time. Then he went to the floor and walked about, later going to *L* and discovering the food. Stowing it in his cheeks he went up to *X* and ate it. When it was gone he wanted to go up to *2t* again, but was not allowed to do so. He then perched at *X*, and looked about for some time. Going to the floor, he stopped at *L*, looked in, took hold of *2k*, dropped it, looked at *L* again and walked away. He climbed to *X*, and returned to the floor after a little while. He took *2k* in his hands, dropped it and looked into *L*. Then he carried *2k* up to *X* and played with it.

Second test. The conditions were the same as before. No. 5 was not so frightened and worked at once. The record of No. 13 was:

Performance 1. No. 13 saw very well.

P. 2, P. 5, P. 6. No. 13 did not see.

P. 3 and P. 4. No. 13 saw well.

P. 7 and P. 8. No. 13 saw No. 5 get food, but did not see the pull.

P. 9. No. 13 saw, but did not seem attentive.

Of the nine times that No. 5 got food No. 13 saw the whole performance four times and in part twice. No. 5 was then removed and No. 13 was released. At once he went to *L* and got a grain of sunflower seed that No. 5 had left, and carrying it up to *X*, ate it. He then wanted to go to *2t*, but was not allowed to do so. He went down to the floor and to *L*, merely looked at it and passed on to the door. He returned to *L* at once. Searching about he found another seed, which he carried up to *X* and ate. When the food was gone he attempted to go up to *2t*, but was prevented. He went to the floor and walked about, going to *L* twice. Once he looked at *2k*, took

it in his hand, but did not pull. After looking at it a moment he carried it up to *X*, where he bit at it and dropped it. Then he went to the floor, walked about, and climbed back up to *X*, where he remained during the remainder of the time.

Third test. This test was made immediately after the previous one and the conditions were the same. The record of No. 13 was:

Performance 1 to P. 5. No. 13 saw the whole performance and was very savage in his demonstrations toward No. 5, jumping at the side of the cage with wide-open mouth.

Only twice did No. 13 turn his head away from No. 5 and then only for a moment each time.

No. 5 was now taken out and No. 13 was released. He was very slow of movement walking about the floor. Twice he went to *L*, and then climbed the wire to *X*, where he perched for a little while. Going to the floor, he passed the door and thence to *L*, looking into the hole several times. In one hand he took *3k* and in the other he took *2k*, but did not pull at either. Dropping both he climbed the end of the cage, but returned at once to the floor. Stopping at *L*, he clawed the opening with his hand and then climbed the wire to the brace. Going to the floor he tried the door where he had entered the cage and went to *L*, returning again to the door.

For several minutes he worked at the door trying to open it. Once he stopped to turn about and look in at *L*, but renewed his efforts at the door immediately. Giving up opening the door, he went to *L*, took *3k* in his hands, dropped it and started to carry *2k* up the wire, but dropped it; climbed to *X* and perched, playing with 7 and *7k*.

Fourth test. Conditions were the same as in the previous test. The record of No. 13 was as follows:

Performance 1. No. 13 saw plainly.

P. 2. No. 13 did not see and did not seem to be interested as on the day before.

P. 3. and P. 4. No. 13 saw.

P. 5. No. 13 saw very well.

P. 6 and P. 7. No. 13 did not see.

When No. 13 was released he at once climbed to *X*, returning to the floor immediately. Going to *L* he looked in and put his hand into the opening. Passing up by *X*, he tried to get up to *2k*, but was not allowed to do so. He returned to the floor and walked about; climbed to *X* again; and, returning to the floor, he went to *L* and looked in. He then climbed to *X* and up and down the wire end of the cage. Once again he went to *L* and put his hand into the opening.

Fifth test. No. 5 and No. 13 were put into the cage together this time.

Performance 1. No. 13 was at *X* when No. 5 pulled the string the first time; he saw her pull and saw her get food. Climbing down he got the food which No. 5 had not yet eaten. He then became very threatening and No. 5 was frightened.

P. 2. No. 13 saw again from *X* and got the food as before. No. 5 was still afraid of No. 13, who was threatening. When No. 13 had eaten the

food he did not climb the cage as before, but kept near *L*. Only once did he go up, and then to chase No. 5.

P. 3. While No. 13 was at the brace after chasing No. 5 down No. 5 pulled the string. No. 13 saw this and after a moment he went to *L* and got the food. From this on he came to the floor whenever he saw No. 5 near *L*. In her turn No. 5 assumed a threatening attitude toward No. 13.

P. 4. No. 13 saw perfectly from the brace and came slowly down and got the food. No. 5 was not inclined to eat the seeds, having an appetite only for grapes.

P. 5. No. 13 saw while on the floor. No. 5 got the grapes and No. 13 got the seeds.

P. 6. No. 5 pulled the string while No. 13 was climbing the wire. He jumped to the floor and rushed to *L*; No. 5 fled up the wire.

P. 7. No. 5 pulled the string when No. 13 was eighteen inches away. He rushed to *L* and got the grape. A moment later when No. 5 went near the opening, No. 13 rushed to the place and kept such a close watch that for some time No. 5 could not get near *2k*.

P. 8 to P. 10. No. 13 saw from *X* and drove No. 5 away before she could get the food.

P. 11. No. 5 got the grape and No. 13 got the seeds and went up to *X* to eat them.

No. 5 was now removed. No. 13 finished eating the seeds he had gotten and then went to the floor, to *L*, and back up to *X*. He spent almost the entire ten minutes at *X*. Near the end of the time he went to *L* and examined it carefully. Then he looked up at knobs *2k* and *3k*, put his hand on *2k*, took it off, and looked back at *L*. He then climbed to *X*, returned to *L*, and went back to *X*.

Sixth test. No. 13 and No. 5 were put into the cage together again. No. 5 was afraid of No. 13 and kept away from him.

Performance 1. No. 5 pulled the string and got the food. No. 13 saw from the wire near the top of the end of the cage. Coming quickly to the floor, he searched *L* vigorously.

P. 2. No. 5 pulled the string. No. 13 saw plainly and went to *L*. He tried to get food, but No. 5 had taken it.

P. 3. No. 13 saw while on the floor near *L*, and going to the place searched a long time for food. Twice he put his hand on *2k*.

P. 4. No. 13 kept near No. 5 at *L*, and when she pulled the string she had to reach her arm over the head of No. 13. His whole attention was on her movements and he saw perfectly.

P. 5. No. 13 was beside No. 5 at *L* and saw perfectly. He got the grape and frightened No. 5 away.

P. 6. No. 13 saw perfectly, got the food and sat by *L*, so No. 5 did not return. Once he put his left hand on *2k* and straightened out his arm as if to pull, but he did not exert much force on the string. Immediately he thrust his other hand into *L*. Again he took *2k* in his left hand, straightened his arm as before, immediately afterward thrusting his right hand

into *L*. A third time he put his left hand on *2k*, straightened his arm and followed this action by thrusting his right hand into *L* as before. He then went away from *L*.

P. 7 to P. 10. No. 13 watched No. 5 carefully and drove her away from the food, which he ate. He then went up to *X* and watched No. 5. When she went near *2k* he dashed for *L*.

No. 5 was now removed and No. 13 was left alone in the cage. Not all the food that No. 5 had brought down had been eaten, and No. 13 continued eating, going to *L* to get the seeds and climbing to *X* to eat them. When he could find no more food he sat at *L* and scratched the edge of the opening with his hand. Then he grabbed *2k* and pounded it against the board; taking *3k* in his right hand and *2k* in his left, he pounded them together; afterward he did the same with *2k* and *1k*. He then went up to *X* and perched for a moment, but almost immediately went to the floor and to *L*. Thrusting his hand in he searched for food and then looked into the opening intently. Looking up, he took hold of *2k* with his left hand and pounded the board with it vigorously, then bit it and dropped it. Taking *2k* in his hands he went up to *X*, dropping the string as soon as he was settled on the brace. His eyes turned at once to *L* and he went down to it and searched for food; he picked up *2k* in both hands and looked at it carefully; then he pounded the board with it. Dropping it he went up to *X*, returning at once to *L*; he grabbed *2k* in his hand, put it gently against *1k* and dropped both of them; he returned to *X*, and, coming down to *L*, he did the same thing over with *2k* and *1k*. He went up to *X* and tried to go up to *2t*, but was prevented. He then perched at *X*, looking at *L* for one minute. He was intent on the getting of food at *L*, but he seemed puzzled. After looking intently at *L* and the strings he went to the floor and to *L*, stopping to sit down and look the string and opening all over. Then he again went up to *X*.

Again No. 13 left his place at *X* and went to the door, pushing on it in an effort to get out. Being unable to get out, he turned away from the door to *L* and sat down in front of it. Quite slowly he looked it all over and, in the same deliberate manner he looked up to *2k*, took hold of it with his left hand and gave a steady and vigorous pull. The food dropped to the bottom of the chute and his right hand shot into the opening and pulled it out. The food was soon eaten and No. 13 immediately pulled the string again with his left hand, getting the food in the same way as before. Without once leaving his place, he pulled the string six times, eating the food between the pulls. While eating the food the third time, he put his hand up to *2k* several times, but he did not pull hard enough to get the food. When his food was gone, however, he pulled the string with a jerk and the food came. Repeatedly he dallied with the string in this manner while eating the food, but he never failed to give a vigorous pull when the food was gone. For fifteen minutes he sat before *L*, getting food repeatedly. He pulled the string fourteen times in addition to the ones already mentioned, a total of twenty times in all. The time from the removal of No. 5 until No. 13 got food the first time was twelve minutes.

TABLE 33.

## No. 13 IMITATING No. 5.

Date.	Number of times No. 5 performed the act.	Number of times No. 13 saw the entire performance	Number of times No. 13 saw in part.	Result.	Time in minutes.
Aug. 25.....	7	4	1	F	10
Aug. 25.....	9	4	2	F	10
Aug. 25.....	5	5		F	10
Aug. 26.....	7	4		F	10
Aug. 26.....	11	9		F	10
Aug. 27.....	10	10		S	12
Total.....	49	36	3	S	62

*Summary of the Results of the String Experiment.*

After No. 13 had failed to solve the problem in his preliminary trials, he was allowed to see No. 5 pull the string. During the first tests he was confined in the observation-box. After four tests he still failed, when left alone in the cage. He was then put into the experiment cage with No. 5. The two animals were strange to each other, and No. 13, being the larger, was inclined to follow No. 5 about the cage, punishing her as opportunity offered. Because of this, he was usually near No. 5, when she pulled the string, and often frightened her away before she could get the food. After she had been removed, No. 13, repeatedly searched the food opening, and worked alternately with the three strings nearest the food opening. He seemed to have associated the strings with the getting of food.

When No. 5 was put back into the cage, No. 13, was more attentive than formerly. After No. 5 had been removed, No. 13, worked more continuously at *L* and at the strings. He now singled out string 2 from the others. He grabbed the knob at the end of the string, in his hands; he pounded it against the board, carried it up the wire, and pounded it against the knobs attached to the other strings. Frequently, during this behavior he dropped the string and searched *L* for food. He had advanced one step in his learning. It was not strings that were associated with the getting of food, but it was a particular string.



The only possible explanation for this centering of attention on a particular string, was that No. 13 was imitating the act of No. 5. By repeated and varied effort, No. 13 finally repeated in exact detail the behavior he had witnessed.

TABLE 34.

## RESULTS OF THE STRING EXPERIMENT.

## I.

Number of animals used in imitation tests.....	1
Cases of successful imitation.....	1
Cases of partially successful imitations.....	0

## II.

Cases of imitation when the imitator was confined during the activity of the imitatee.....	0
Cases of imitation when the two animals were together in the cage.....	1

## III.

Cases of immediate imitation.....	0
Cases of gradual imitation.....	1

## IV.

Cases of imitation in which the imitating animal <i>did not</i> himself experience the result of the act before performing it.....	0
Cases of imitation in which the imitating animal <i>did</i> experience the result of the act before performing it.....	1

## V. GENERAL SUMMARY OF RESULTS AND CONCLUSIONS.

*Cases of Imitation.*

(a) *With Respect to the Several Experiments.*—The seven experiments (Chute Experiments A and B are counted as one) to which the several animals were subjected, yielded a total of sixteen cases of successful imitation, three of which were immediate, and five cases of partially successful imitation. No one of the experiments failed to yield at least one case. Four of the experiments yielded imitation, successful or partially successful, for every animal given the full series of tests (100). The other three gave a total of five failures.

In tabular form this appears as follows:

	CASES OF IMITATION.	CASES OF FAILURE TO IMITATE.
Chute Experiment A and B.....	5	2
Rope Experiment .....	4	0
Paper Experiment .....	3	0
Screen Experiment.....	3	2
Plug Experiment .....	2	0
Button Experiment .....	3	1
String Experiment .....	1	0
	—	—
TOTAL .....	21	5

(b) *With Respect to the Individual Animals.*—Of the eleven animals used, all but two exhibited imitative behavior. These two were given the full series of imitation tests and are recorded as absolute failures. Of the nine animals which exhibited imitative behavior, seven were successful in each experiment in which they were used. No. 3 succeeded twice and failed twice; No. 6 succeeded four times and failed once. No. 5 made the best record, solving three of the problems alone or with slight help from the experimenter and learning all the others (four) by imitation. The record of No. 2 is almost the same, but he required more aid from the experimenter in learning one of the tricks. No. 4 learned two tricks alone, failed on two, and learned three by imitation. No. 9, No. 10, and No. 11, each had one opportunity to manifest imitative behavior, and no one of them failed to do it. No. 13 had two opportunities and imitated in both cases.

On the basis of their ability to learn by imitation the animals may be arranged in three classes.

The first includes those animals which did not manifest a failure. Here would come No. 2, No. 4, No. 5, No. 9, No. 10, No. 11 and No. 13.

In the second group are the animals which succeeded in some tests and failed in others. Here are No. 3 and No. 6.

The third group contains those animals which failed to manifest imitative behavior. Here are No. 1 and No. 8.

The accompanying table exhibits the records of the individual animals.

TABLE 35.  
RECORD OF INDIVIDUAL ANIMALS.

Number.	No. of experiments learned independently.	No. of experiments in which imitation tests were given.	Cases of imitation.	Cases of failure to imitate.
No. 1.....	0	1	0	1
No. 2.....	2	3	3	0
No. 3.....	1	4	2	2
No. 4.....	2	3	3	0
No. 5.....	3	4	4	0
No. 6.....	1	5	4	1
No. 8.....	1	1	0	1
No. 9.....	0	1	1	0
No. 10.....	0	1	1	0
No. 11.....	2	1	1	0
No. 13.....	2	2	2	0

(c.) *With Respect to the Several Species.*—The number of cases of imitation per species is of interest. The results show that the tendency to learn by imitation is not confined to any one species or genus among those studied. The number of animals used is too small and the variation in the number of experiments to which the several animals were subjected is too great for these results to have any significance in showing the relative imitative ability of the various species.

<i>Cebus</i> (6 specimens) .....	17
<i>Cebus lunatus</i> (2 specimens).....	7
<i>Cebus fatuellus</i> (1 specimen).....	3
<i>Cebus capucinus</i> (1 specimen).....	4
<i>Cebus flavus</i> (1 specimen).....	1
<i>Cebus hypoleucus</i> (1 specimen).....	2
<i>Macacus</i> (3 specimens) .....	4
<i>Macacus rhesus</i> (2 specimens).....	2
<i>Macacus cynomologus</i> (1 specimen).....	2

Of the two animals which failed one was a *Cebus lunatus* and the other was a *Cebus hypoleucus*.

TABLE 36.

## THE RESULTS OF THE SEVEN EXPERIMENTS.

I.	
Number of animals used in imitation tests.....	*26
Cases of successful imitation.....	16
Cases of partially successful imitation.....	5
Cases of failure to imitate.....	5
II.	
Cases of imitation when the imitator was confined during the activity of the imitatee.....	8
Cases of imitation when the two animals were together in the cage.....	13
III.	
Cases of immediate imitation.....	5
Cases of gradual imitation.....	16
IV.	
Cases of imitation in which the imitating animal <i>did not</i> himself experience the result of the act before performing it.....	11
Cases of imitation in which the imitating animal <i>did</i> experience the result of the act before performing it.....	10
V.	
Cases of imitation where the result of the act was obtained at the place where the act was performed.....	16
Cases of imitation in which the act was performed at one place and the result was obtained at another place.....	5
*Counting each animal once for each experiment in which it was used.	

2. *Features of Imitative Behavior.*

(a) *Relation Between Animals.*—It is significant to note that imitation did not always occur between animals thoroughly accustomed to each other. It might be supposed that congeniality between animals was a good condition for imitation, but that this is not necessarily so the results of my experiments seem to indicate. As I shall show later, familiarity tends to lessen attention, to make each animal follow its own tendencies. Strangeness and a certain amount of pugnacity seem effective in arousing attention, which is the first condition for imitation. In the String Experiment No. 5 was a total stranger to No. 13 and the latter was highly attentive

to her every movement. The same is true of No. 2 and No. 4, of No. 4 and No. 11 and of No. 4 and No. 13 in the chute experiment. The cases of imitation between animals wholly congenial are less than one-half of the cases recorded.

(b) *Levels of Imitative Behavior.*—Monkeys react to the presence of one another in various ways. At least four levels of reaction are well defined. The first of these is characterized by the simple arrest of attention. One animal walks across the floor of the cage or climbs a pole, and another animal looks in its direction. That monkeys manifest this sort of reaction requires no extended experimentation to prove. Every moving object, and much more, every moving monkey catches their attention. In my investigation the cases where animals failed to respond in this way may be grouped into two classes. The first group has to do with animals which, through being caged together, had become thoroughly accustomed to each other's behavior. No. 6, who had lived in a cage with No. 4, often seemed unaffected by her conduct when he was put into the experiment cage with her. He would go about the cage hunting food and pay no attention to the actions of No. 4 who might be getting food at the time. If, however, under the same circumstances, No. 2, a strange animal, was substituted for No. 4, No. 6 would become alert and apparently see everything No. 2 did. There were other cases of the same sort.

The other group of cases are those in which one animal had whipped another. The whipped animal usually attended to his enemy only to avoid him. When the latter's attention was directed toward some object in a distant part of the cage, the vanquished animal went about hunting food for himself and did not see what the other animal did. It was, of course, quite otherwise with the bully. He was usually inclined to watch his victim, unless something more interesting presented itself.

These cases in which the attention of a monkey was not attracted by the act of another monkey seem explainable by the circumstances under which they occurred. They serve, therefore, to emphasize more strongly the point that monkeys do tend to give attention to the acts of one another. Since such attention is the invariable ante-

cedent of any behavior that may be called imitative it is important to note that it exists.

A level of social response more advanced than mere *looking* is *following*. Here again, it requires but little observation of monkeys to show that the tendency to follow is very strong, especially among the *Cebus* monkeys.

More complicated than mere *looking* or *following* is behavior of this sort: One animal performs an act, gets food in a given locality and goes away. Another animal which observes this behavior goes, immediately after, to that locality, as if to get food. What the second animal does in that locality seems at this level of behavior to have no relation to the behavior of the first animal. There were numerous instances of this sort of behavior among the animals which I have studied. In the Screen Experiment, in particular, there were clear cases. No. 5 repeatedly went to the corner of the cage where No. 4 had gotten food by lifting the screen. The same was true of No. 2, but in neither of these cases did the imitating animal repeat the behavior of No. 4 with sufficient definiteness to succeed. In Chute Experiment B, No. 11's attention was directed to the chute but not to the end of it. When we take account of the fact that No. 5, No. 2, and No. 11, in the instances noted, changed their behavior either in form or in strength from what it had previously been, it is fair to speak of their behavior as imitation. This is the simplest form of behavior to which I have applied the term in this paper. In such cases I have spoken of partially successful imitation.

More clearly entitled to be called imitation is that behavior in which the animal responds to an imitator, not only by going to a definite locality, but by attacking a particular object. In his imitation test in Chute Experiment B, No. 13 went at once to the end of the chute, thrust his hand up the inside, grasped the string, and pulled. The same was true of No. 4, and of No. 6 in the same experiment, of No. 6 in the Rope Experiment and of No. 4 in the Button Experiment. In these cases, attention was centered on a definite object. This investigation presents a number of other cases of similar behavior. It was not always true that when a monkey

attacked the right object he repeated the movement of the imitator in detail. The impulse seemed to be to do something to the object, and the imitating animal used his hands and teeth interchangeably. As a result the behavior of the imitator was often ill adapted to secure the profitable result. Repetition of the act usually refined such behavior until it was correct.

The most perfect type of imitation is exact repetition in detail of the act of the imitator. The case of No. 13 in the Chute Experiment already cited is an example. So also is the behavior of No. 3 in the Button Experiment, and of No. 6 in the Rope Experiment. The investigation furnishes a number of other cases which are approximately as good.

(c) *The Stimulus to Imitative Behavior.*—Some of the animals which I have studied learned to manipulate mechanisms unaided. No. 2 did this with the chute, No. 4 did it with the screen, and a number of the monkeys learned to get food by tearing the paper. In the case of the Paper Experiment and in the case of No. 2 in the Chute Experiment, the stimulus was the mechanism itself. That the mechanism was not a sufficient stimulus in many cases is evident from the large number of failures to learn unaided which the investigation furnishes.

In the Chute Experiments eight different animals were given the preliminary trials and of these six showed no interest in the end of the chute, most of them not even going to it. This, of course, does not prove that they might not have learned how to get food if the trials had been indefinitely prolonged, nor is it necessary to prove this latter thesis in order to interpret the behavior of the monkeys as imitation. What these preliminary tests do establish is *the improbability that a sudden change of behavior should occur in the sixth trial with 70% of the animals used.* For the stimulus to this sudden change we must look to something other than the mechanism itself.

It may not be out of place at this point, to say a word in reply to a criticism often made upon the use of animals kept in a zoölogical garden. The criticism is, that such animals have had innumerable opportunities to learn to do acts about which the experimenter can-

not know, and hence he cannot tell what causes his animals to act as they do. This criticism does not hold against this investigation for every animal was given abundant opportunity to manifest his random activities and to exhibit his stock of tricks. That the situations were unfamiliar is evidenced by the animals' repeated failures to learn. That this criticism is less important than it has been made to seem is evidenced by two facts which come out in this study. First, of the two animals which made the best records in the investigation, No. 5 and No. 2, one had been in the garden several years, the other had never been in the garden until June, 1908, when he was shipped there from Cambridge. He had been bought from a dealer and was presumably fresh from the forest. The other fact is that not one of the Park monkeys learned to work the chute unaided, whereas No. 2 did.

The additional stimulus in the imitation tests was an animal working at the mechanism and food coming from the mechanism. The relative value of these two elements in the imitation-stimulus, this investigation does not show. That in certain *cases the presence of the animal was necessary*, there is sufficient evidence. The behavior of No. 6 in the Screen Experiment is a case in point. No. 6 had seen the screen lifted in the Paper Experiment. Immediately thereafter, he had torn the paper and obtained food. He had done this repeatedly and thus had learned that there was food behind the screen. Yet throughout his entire preliminary trials he failed to lift the screen. It was only after he had seen No. 4 get food by lifting the screen that he did the act himself.

The case of No. 5 in the Button Experiment illustrates the same thing. She had had a great deal of experience with the slide door. Over and over she had served as the imitatee in the Plug Experiment and had eaten more than a dozen bananas which she had gotten after opening the door. Yet she was helpless to get the food when the door was opened by the button. She learned to push the button by watching No. 2 push it.

On the other hand, *there is evidence to show that in certain cases the behavior of the animal unaccompanied by any profitable result is not sufficient to produce imitation*. In general, the monkeys did



not display much tendency to repeat the *mere acts* of other monkeys. That they did not imitate in this way may have been due to the conditions of the experiments. Where opportunity was given for imitation, food was given as a reward. It often happened that when the attention of the imitator was only slight it would be greatly accentuated when the imitatee began to get food. No. 10 and No. 11 were kept in the same cage. No. 10 whipped No. 11 and treated him with indifference. Yet when she saw him get food in the Paper Experiment, she at once showed an accentuation of the objective marks of attention. In the Rope Experiment, No. 2 was indifferent to the behavior of No. 3 until he saw No. 3 with food and his attention was not drawn to the food door until he saw No. 3 get food there. His interest in No. 3 steadily increased until he got food for himself. The same comment may be made upon the behavior of No. 3 when watching No. 2 in the Paper Experiment. In general, No. 4 lorded it over No. 6 and No. 5 when in the living cages, but she invariably became attentive to them when she saw them getting food in the experiment cage.

Thus the facts would indicate that not only the act of the animal, but also the profitable result of that act was a necessary factor in producing imitation. By further experimentation I hope to discover the relative importance of these two elements.

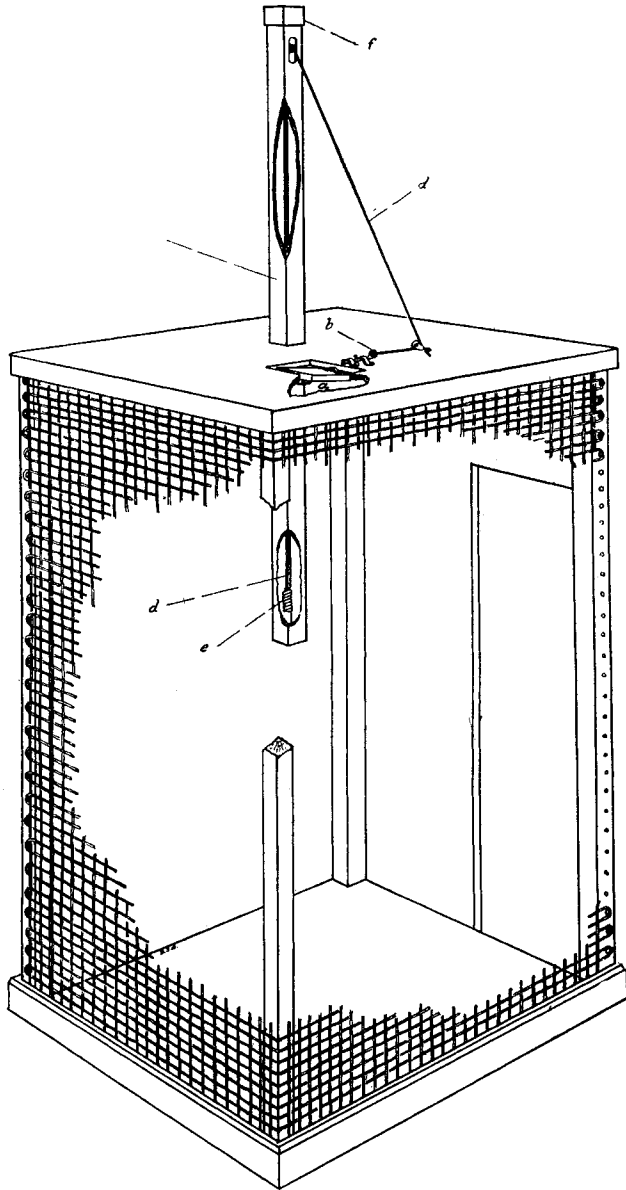


FIG. 1. Old cage (see text, p. 355), Chute Experiment A. *a*, trap door; *b*, device to hold door shut; *c*, chute; *d*, string; *e*, iron for monkey to grasp. (Drawn by B. Spencer Greenfield.)

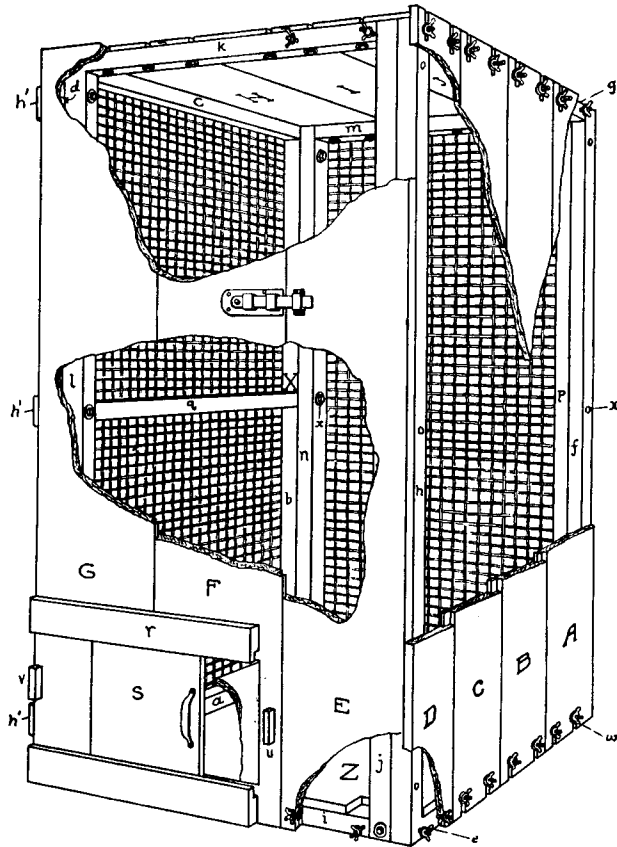


FIG. 2. New cage (see text, p. 351). *a, b, c, d*, front frame; *e, f, g, h*, back frame; *i, j, k, l* and *m, n, o, p*, end frames; *g*, brace across front of cage; *x*, bolts holding frames together; *A, B, C, D*, boards covering back of cage; *E, F, G*, boards covering end of cage; *F* and *G*, door; *H, I, J*, boards covering top of cage; *Z*, floor; *S*, slide door in large door; *w*, door hinges; *w*, wing nuts; *X*, end of brace where animals frequently perched. (Drawn by B. Spencer Greenfield.)

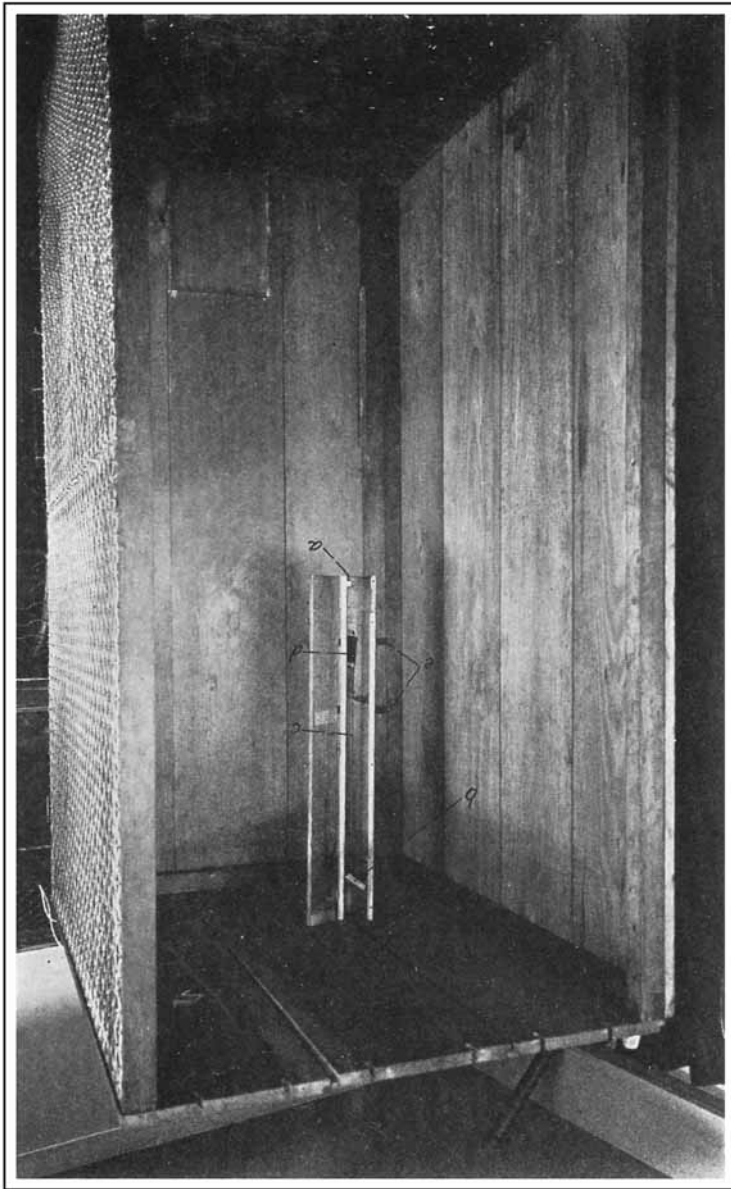


FIG. 3. New cage showing chute, *a*, with one side open; *b*, trap door; *c*, string; *d*, wire spring handle; *e*, rungs. Page 358.

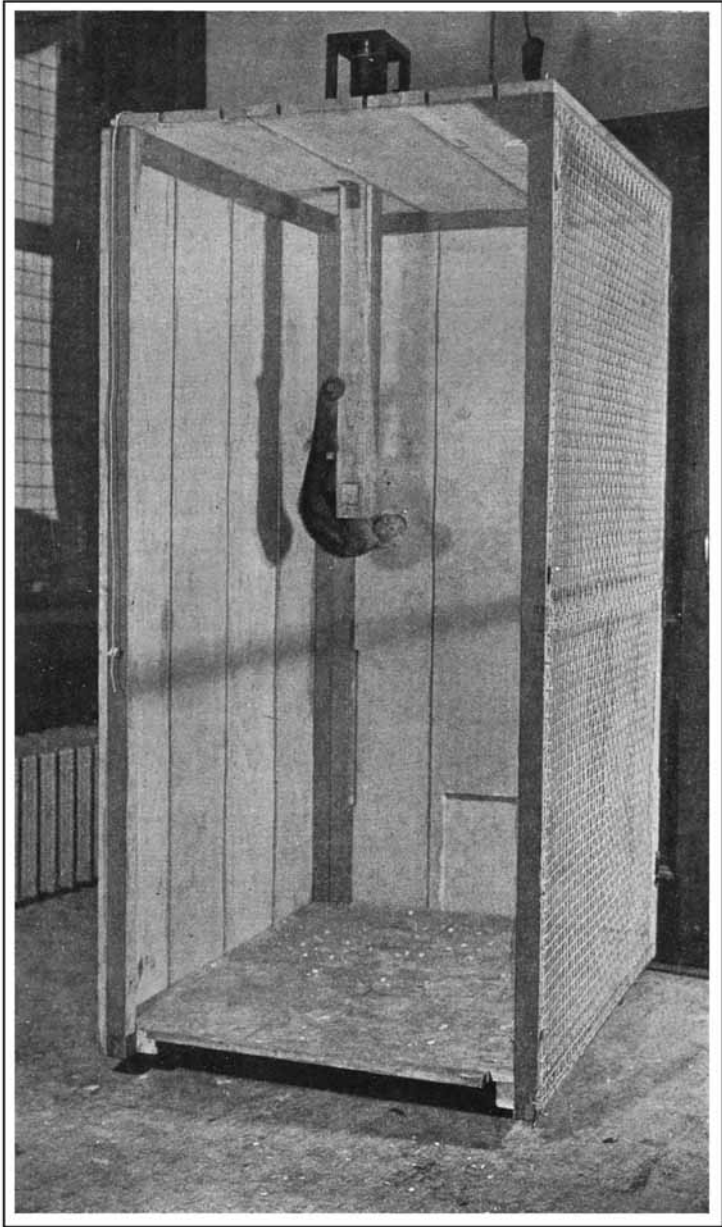


FIG. 4. No. 2 getting food in Chute Experiment B, characteristic position.  
Page 358.

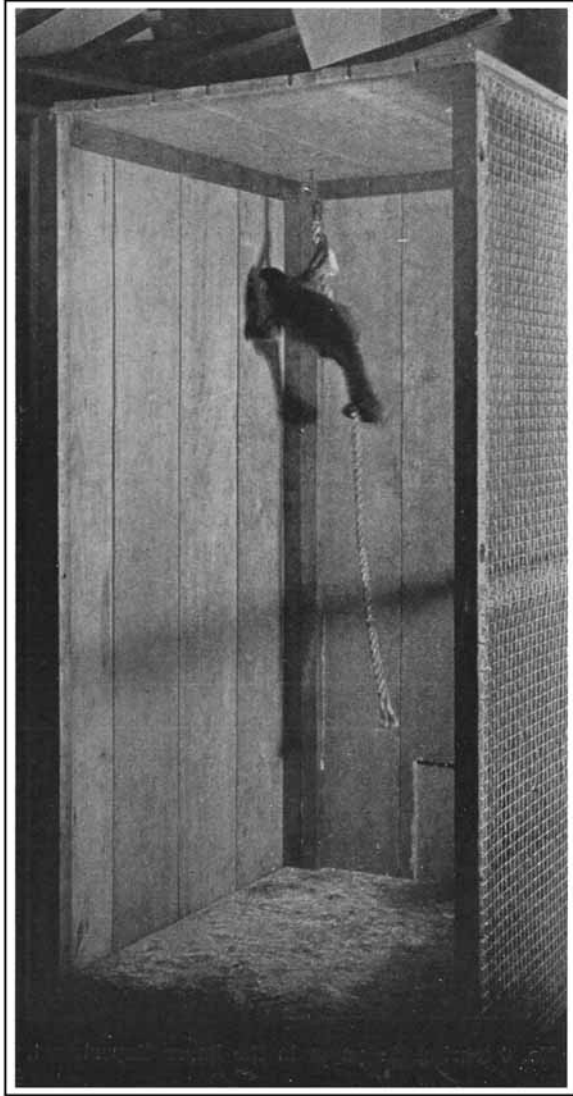


FIG. 5. No. 6 getting food in the Rope Experiment. Page 385.

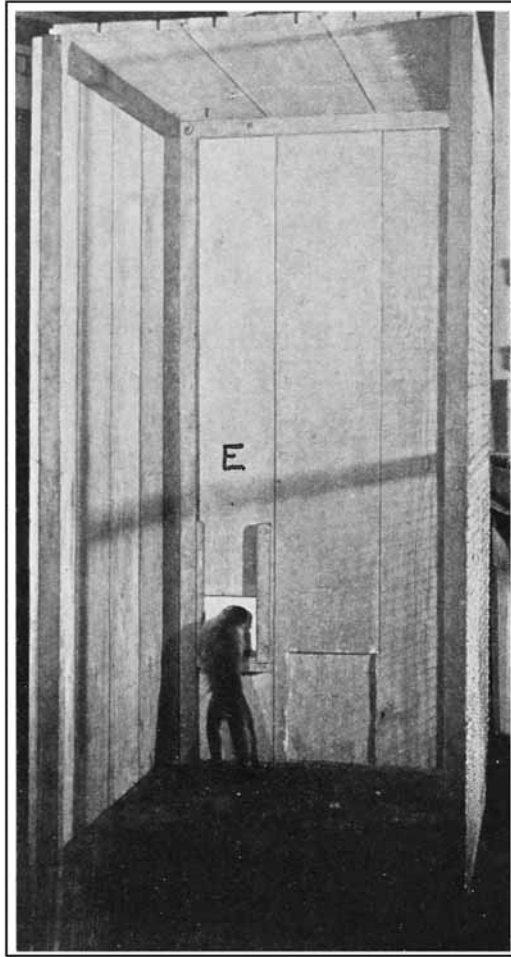


FIG. 6. No. 6 tearing the paper in the Paper Experiment. Page 391.



FIG. 7. No. 4, to the right, pushing up the screen,  $\alpha$ , in the Screen Experiment. Page 400.



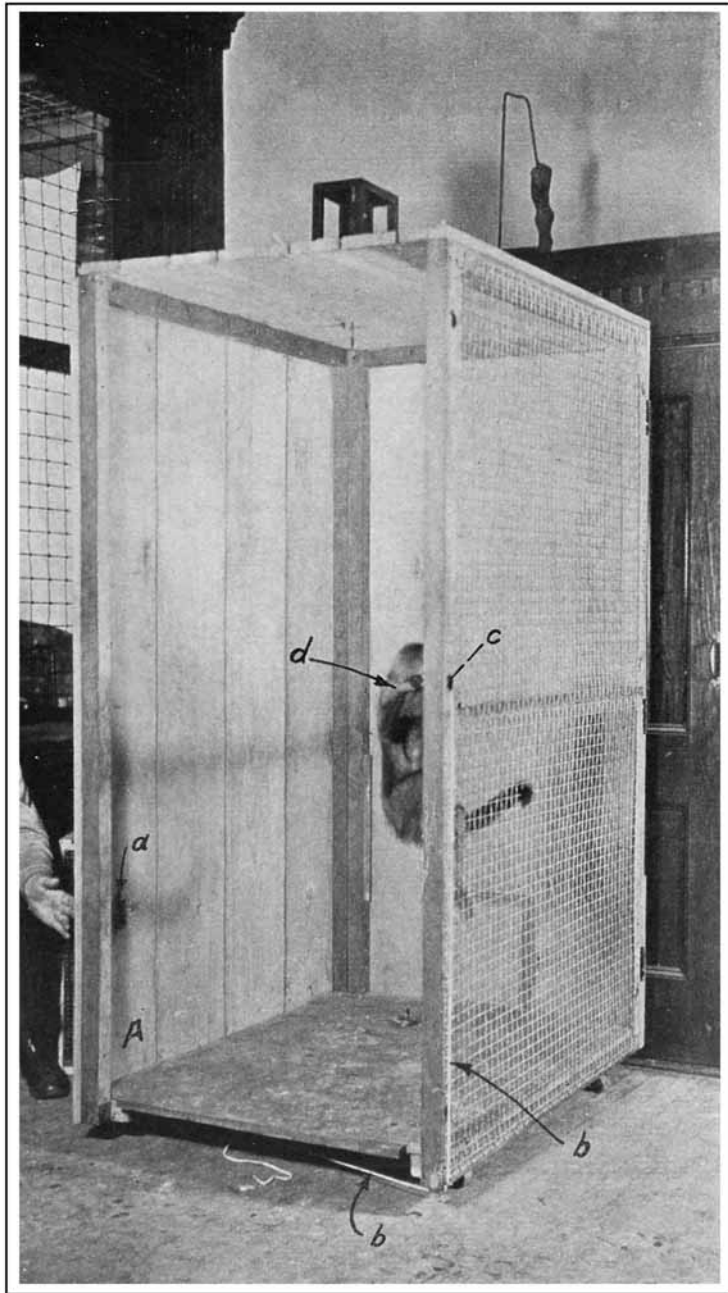


FIG. 8. No. 5 pulling the plug in the Plug Experiment; *a*, slide door; *b*, string; *c*, plug. Page 411.

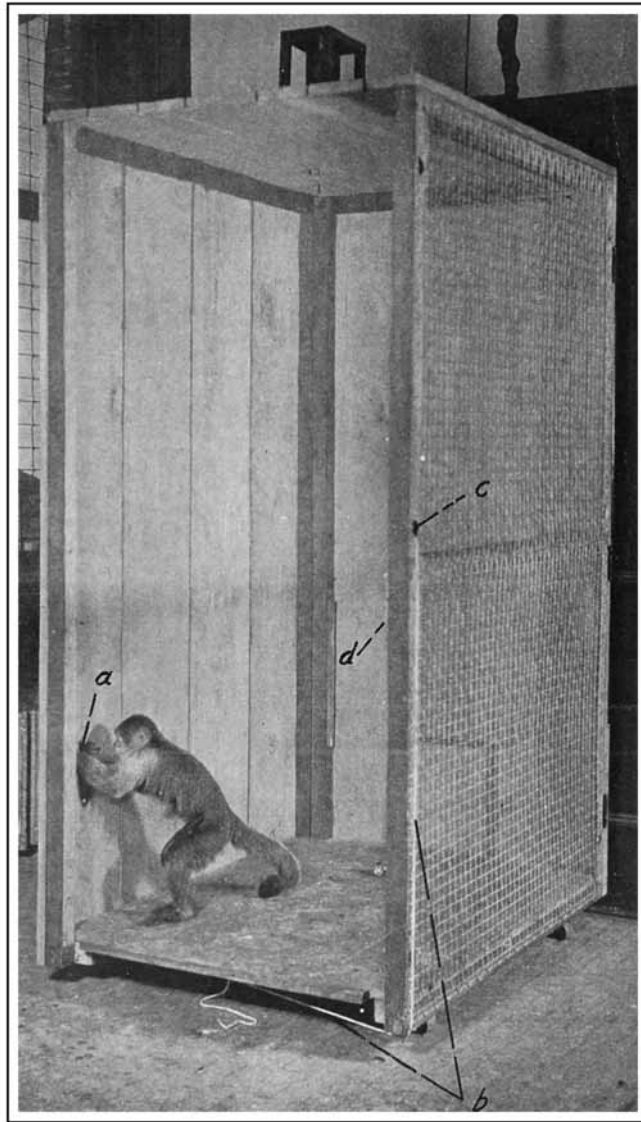


FIG. 9. No. 5 getting food after pulling plug (FIG. 8); *a*, slide door; *b*, string; *c*, plug. Page 412.

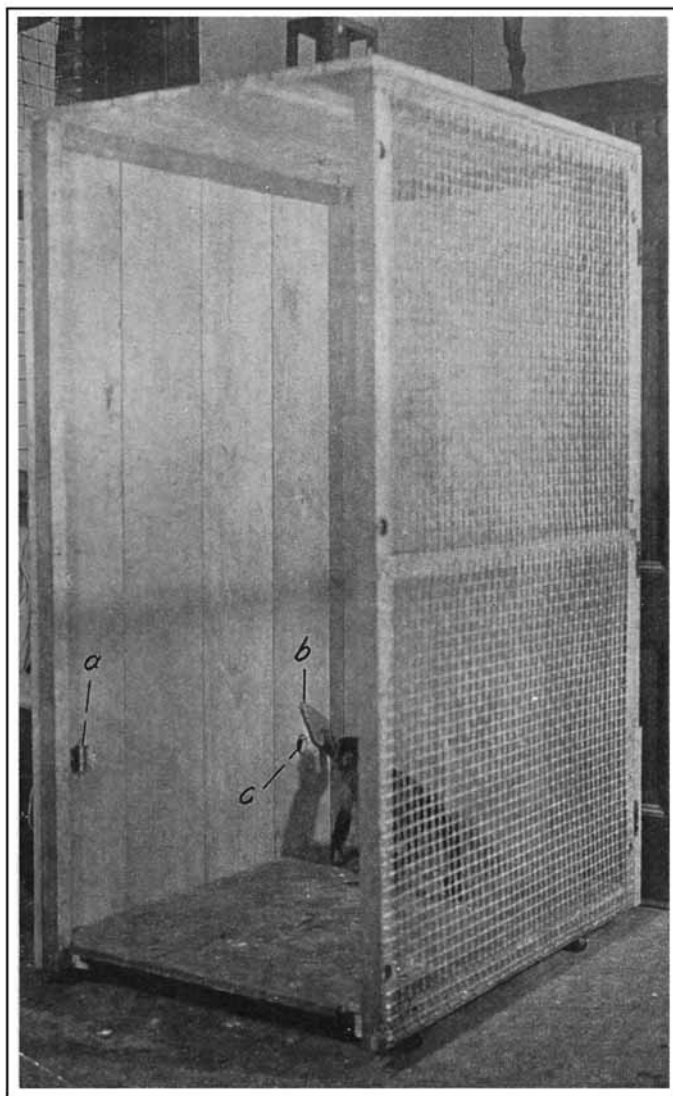


FIG. 10. No. 4 pushing the button, *b*, in the Button Experiment; *a*, slide door; *c*, string. Page 419.

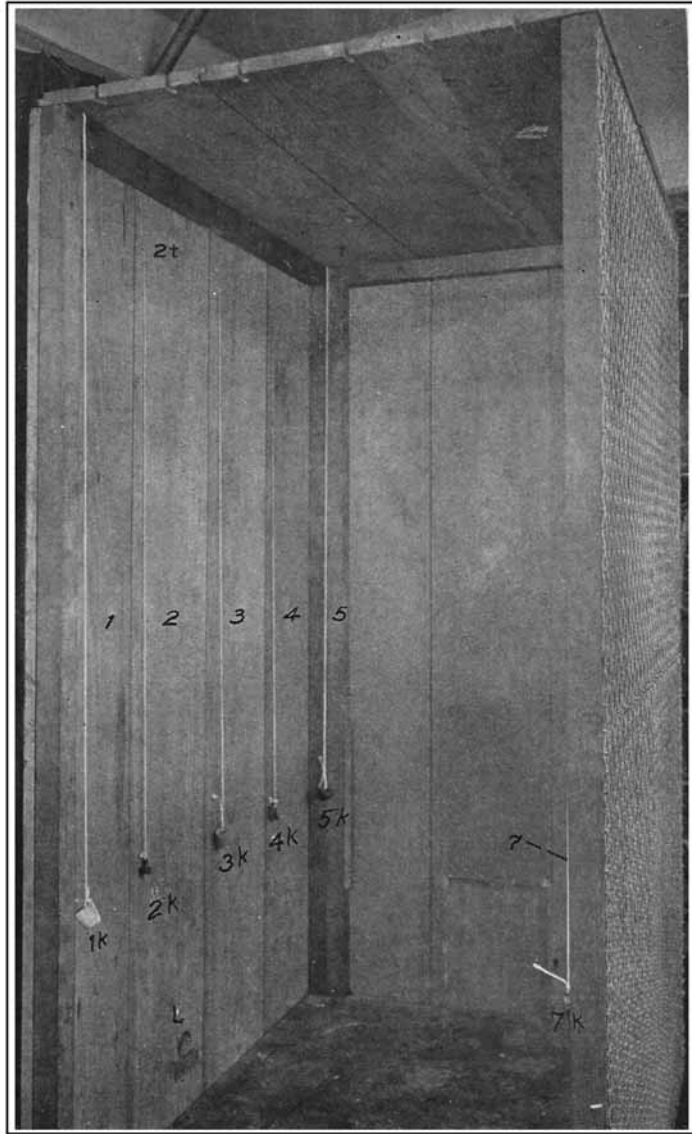


FIG. 11. New cage adjusted for the string experiment; *L*, opening where food came into the cage; 1. 2. 3. 4. 5. 7. strings; *2t*, where string 2 entered the cage; *2k*, the knob at the end of string 2. Page 425.

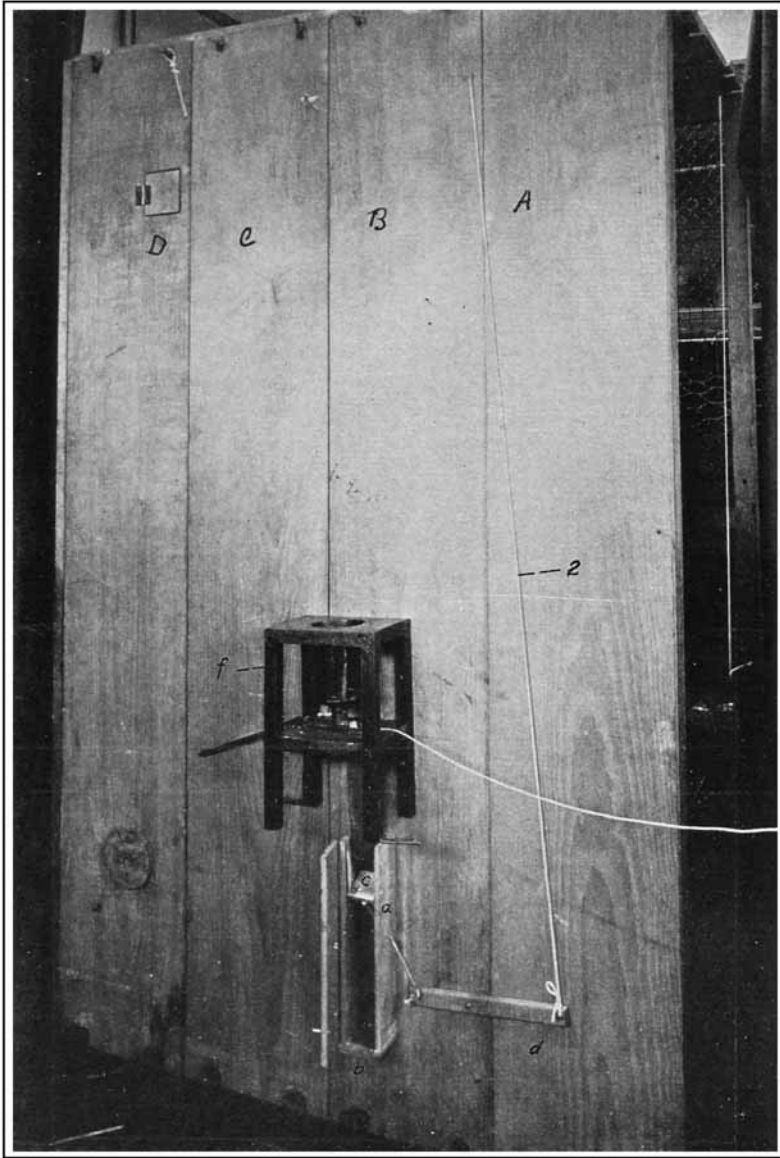


FIG. 12. New cage adjusted for the String Experiment; *a*, chute; *b*, bottom of chute on a level with opening into the cage; *c*, trap door; *d*, lever; 2, string 2; *f*, feeder. Page 426.



FIG. 13. No. 13 getting food in the String Experiment. Page 432.