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I hereby recommend that the thesis prepared under my supervision by Forrest D. Brown

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AN EXPERIMENTAL ANALYSIS OF THE ALLEGED CRITERIA OF INSIGHT LEARNING

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CHAPTER I

THE PROBLEM

Introduction

Since the function of the school is that of teaching, the most fundamental question which the educator can raise is that of how children learn. Turning to the science of psychology for an answer to that question, the educational worker receives varied and contradictory replies. He finds that there are three contemporary schools of psychology with three respective theories of learning. There is the theory of conditioning based upon the fact of the conditioned reflex. There is the theory of learning by trial and error. And there is the theory of insight learning. All three of these schools of psychology make far-reaching claims for their respective theories. In consequence, the average teacher who is not a specialist in the science of psychology stands bewildered rather than enlightened as a result of the controversy.

The theory of the conditioned reflex has been chiefly developed by the Russian physiologists, Pavlow (27) and Bechterew (3), and by Watson and his co-workers in America. In his classical experiment on conditioning the salivary reflex in the dog, Pavlow found

that a stimulus not originally effective in eliciting a reflex could be made so, if presented simultaneously with the native stimulus. Similar studies have been made in America by Watson (41, 42) and Mateer (24). The thesis of the advocates of this theory is that all learning is based upon conditioning and that the so-called higher types of learning are nothing more than the organization of a great number of conditioned reactions.

The second theory, that of learning by trial and error, was first presented fully by Thorndike in his epochal experiments on animal intelligence (37). According to this theory, all learning proceeds by trial and error activity during which the learner tries out all the reactions which make up the repertoire of his congenital and learned responses. The learner gradually varies his responses to the situation until the correct response is made. This successful response comes by chance in so far as its appearance is unpredictable. The outstanding characteristic of learning, according to this theory, is its trial and error nature.

The final theory, that of learning by insight, had its origin in German psychological experimentation. Kohler (19), experimenting with chimpanzees, has given the most significant evidence for this theory. According to Kohler (19), Koffka (18), Wheeler (43), Ogden (26), and others of the Gestalt school, learning proceeds by sudden adaptations rather than by trial and error. These psychologists contend that the learning act is more than a sum of isolated reactions, as the theory of conditioning indicates. They further hold that chance plays no important part in the learning process.

The first theory mentioned, the theory of the conditioned reflex, is fundamentally a physiological theory. Thorndike has recently pointed out that the conditioned reflex has many significant characteristics which have no counterparts in ordinary learning. He believes that the phenomena of conditioned reflexes should be considered as a special case independent of learning in general, rather than as its fundamental basis. In keeping with this point of view, which is supported by the following quotation from Thorndike, the present investigation is restricted to the two remaining theories of learning.

> 1. The connections for any given animal usually have one same response or end term, and that is, or becomes in the course of experimentation, very sensitive or excitable. .... Apparently, there develops a pronounced tendency for the reflex to be influenced by any change in the external situation. Learning to salivate at a certain signal may then be more comparable to learning by a little child to do something other than sitting still when a buzzer sounds to learning to do any particular thing at such a sound.
>
> 2. The tendency is extinguished (i.e., vanishes for the time being) very rapidly if it is repeated frequently with short intervals .... Ordinary learning connections do not act in this way....
>
> 3. Such an extinction or temporary weakening and disappearance of the tendency is curable by disuse of the tendency.... The contrary occurs with ordinary learned connections, which disuse weakens.
>
> 4. The flow of saliva in man is very sensitive, varying readily, as Winsor has shown, in response to chewing, yawning, embarrassment, etc. Yet learning to increase the flow of saliva in response to any orginally irrelevant signal is very, very slow in man, so slow that its possibility has even been denied. In ordinary learning man is usually a much more rapid learner than a dog.
>
> 5. There are other features of connection established in a conditioned reflex which do not now seem to have any counterpart in ordinary learning, though more extensive observations and deeper insight may reveal parallelisms. Thus the temporary extinction of the tendency to respond by saliva flow to the sound of a buzzer by repeating that sound, tends to extinguish also the tendency to respond by saliva flow to the other accustomed signal. This is somewhat as if forgetting that nine times seven is sixty-three made one unable to

say that thirty-three plus thirty is sixty-three .... (40:107-110).

The controversy between the advocates of learning by trial and error and learning by insight centers around two parallel lines of study. First, they differ concerning the theoretical interpretations to be given the overt behavior in the learning process. Secondly, they differ in respect to the neural process which parallels and is basic to the outward behavior. While recognizing the fruitful nature of such neurological studies as those of Franz (11, 12), Lashley (20, 21, 22), Child (7), Herrick (14), and Coghill (8), and the need for further study along this line, the present investigation will be restricted to the study of behavior in the learning process and its interpretation.

The general purpose of this study is to attempt to settle the controversy between the advocates of the theory of learning by trial and error and learning by insight. The present tendency in philosophic interpretation and scientific description is monism. In the light of this tendency it would seem probable that there is only one kind of learning, and that the present dualistic interpretation in terms of two theories is not in keeping with the simplest and most adequate explanation. Which of these two theories is correct? Or is the best theory of learning to be found in a synthesis of both of these theories? Or are there facts which neither theory has yet taken into account, so that a new theory is needed? Before trying to find answers to these questions it will be well to review the pioneer investigations which have given rise to the controversy.

Pioneer Investigations in Learning

Thorndike's Study of Learning in Cats, Dogs, and Chicks.- Although the term "trial and error" was used sometime before, Thorndike definitely formulated it into a theory of learning when he described the learning behavior of his animal subjects in his classic experiments on "Animal Intelligence." (37) Thorndike put animals in enclosures when hungry, from which they could escape by some simple act, such as pulling a loop of cord, pressing a lever, or stepping on a platform. The animal was put inside and food was placed outside, and then his actions observed. The animals used were chicks, cats, and dogs. One of Thorndike's problems was that of whether animals reason. Concerning that he concludes:

> If there were in these animals any power of inference, however rudimentary, however sporadic, however dim, there should have appeared among the multitude some cases where an animal, seeing through the situation, knows the proper act, does it, and from then on does it immediately upon being confronted with the situation. There ought, that is, to be a sudden vertical descent in the time-curve .... Now scores of cases recorded show no such phenomena. The cat does not look over the situation, much less think it over, and then decide what to do. (37:45)

In describing the general learning behavior, he says:

> When put into the box the cat would show evident signs of discomfort and of an impulse to escape from confinement. It tries to squeeze through any opening; it claws or bites at the bars or wire; it thrusts its paw out through any opening and claws at everything it reaches .... The cat that is clawing all over the box in her impulsive struggle will probably claw the string or loop or button so as to open the door. And gradually all the other non-successful impulses will be stamped out and the particular impulse leading to the successful act will be stamped in by resulting pleasure, until, after many trials, the cat will, when put in the box, immediately claw the button or loop in a definite way. (37:13)

Thorndike describes such learning as learning by trial and

error or trial and accidental success. First the animal reacts in terms of the instinctive responses. Certain of these will be selected when they result in the successful act with its attending pleasure; others will decrease when they are unsuccessful and bring only displeasure. The successful acts will be strengthened by repetition while the unsuccessful acts will weaken through disuse. More recently Thorndike has developed the Principle of Belongingness as being more potent than repetition. He says:

> Repetition of a connection in the sense of the mere sequence of the two things in time has very, very little power, perhaps none, as a cause of learning. Belonging is necessary. (40:28-29)

Thorndike's Study of Learning in the Monkey.- In another experimental study using monkeys as subjects Thorndike sought to find how monkeys differed from the other mammals and the adult human being in the general mental functions revealed by their methods of learning. He used learning situations much like those of his former experiment. Food was placed inside a box and a string had to be pulled, a catch unfastened, a bolt pushed clear, etc., before the door of the box would open. No evidence was found of reasoning. He says:

> If we use the word reasoning in its technical psychological meaning as the function of reaching conclusions by the perception of relations, comparison and inference, if we think of the mental content involved as feeling of relation, perceptions of similarity, general and abstract notions and judgments, we find no evidence of reasoning in the behavior of the monkeys toward the mechanisms used. (38:13-14)

Thorndike concludes that in their method of learning the monkeys do not advance far beyond the generalized mammalian type, but in their proficiency in that method they do. They form associations

much faster and form many more of them. They also seem superior in delicacy and in complexity of the associations formed and the connections seem to be more permanent. Thorndike then reaches the conclusion that the higher mental processes of human beings are but secondary results of the general function of having free ideas and that this general function is the result of the formation after the fashion of the animals of a very great number of associations.

Kohler's Study of Learning in Chimpanzees.- Kohler (19) has interpreted the learning behavior of a group of chimpanzees in terms of insight. He uses the term insight as synonymous with intelligent behavior. Such behavior, he says, tends to be called into play when circumstances block a course which seems obvious, leaving open a roundabout path which the human being or animal takes, so meeting the situation. In the case of such insight behavior the objective, the obstruction and also the total field of possible roundabout routes must be in plain sight. Kohler uses the term insight synonymously with ideational activity. He says:

> In the field of the experiments carried out here the insight of the chimpanzee shows itself to be principally determined by his optical apprehension of the situation; at times he even starts solving problems from a too visual point of view, and in many cases in which the chimpanzee stops acting with insight it may have been simply that the lie of the land was too much for his visual grasp. (19:277-278)

And again:

> We can, from our own experience, sharply distinguish between the kind of conduct which from the very beginning arises out of a consideration of the characteristics of a situation, and one that does not. Only in the former case do we speak of insight and only that behavior of animals definitely appears to us intelligent which takes account from the beginning of the lie of the land and proceeds to deal with it in a smooth, continuous course. Hence follows this

characteristic; to set up as the criterion on insight, the appearance of a complete solution with reference to the whole lay-out of the field. (19:198)

The most important of Kohler's experiments were with chimpanzees learning to manipulate sticks and boxes to secure food otherwise out of reach. The following is a review and criticism of one of the most complicated of the problems, - the problem of the jointed-stick which only one chimpanzee, Sultan, solved on his own initiative. Prior to this problem situation Sultan had learned to secure food placed outside the cage too far to be reached with the hand, by using a stick. But in the jointed-stick problem there were two sticks provided, neither of which was long enough to be of use by itself to get the food. The two sticks were hollow bamboo, one stick being enough smaller that it could be fitted into the other, thus making a longer jointed-stick. This jointed-stick was long enough to get the food. When presented with the situation Sultan tried time and time again to get the food with one or other of the sticks. Then he used one stick to push the other one toward the food and succeeded in thus touching the food but not in getting it. Finally the experimenter gave Sultan some help by putting one finger into the opening of the one stick, but with no visible effect. The experiment lasted for an hour, then the experimenter departed, leaving the two sticks with Sultan and the keeper to watch. Here is the keeper's report:

> Sultan first of all squats indifferently on the box, which has been left standing a little back from the railings; then he gets up, picks up the two sticks, sits down again on the box and plays carelessly with them. While doing this, it happens that he finds himself holding one rod in either hand in such a way that they lie in a straight line; he pushes the thinner one a little way into the opening of the thicker, jumps up and is already on the run towards the railings, to which he has up to now half turned his back, and begins to draw a banana towards him with the double stick .... (19:132)

Kohler interprets this as learning by insight. It seems highly probable that a simpler and more adequate interpretation is possible. The only new element for Sultan to learn in this experiment was to put the two sticks together. In former tests he had learned to get food with one stick. He had learned to choose the longer of two sticks which alone was adequate to get the food. His trial and error activity in the former part of the present experiment taught him that either of these sticks were too short to be effective, though he seems to have learned this very gradually, repeating the attempt many times after failure. Once holding in his hand the jointed-stick he had only to transfer past experience to the situation to perceive that this longer stick would probably be effective. The question, then, is how he learned to join the sticks together. The answer seems to be that he learned merely by chance; it just happened. But Kohler holds that insight is fundamental to chance:

> Thus Sultan's behavior, when he has once carried out his usual play, 'put stick in hole', with both the bamboo rods, is exactly the same as if he had discovered the new procedure in a genuine solution. After this there is no doubt that he makes use of the double stick technique intelligently, and the accident seems merely to have acted as an aid .... fairly strong, it is true .... which led at once to 'insight.' (19:202)

It seems to the writer that it is possible to interpret the facts of overt behavior in the learning situations described in the investigations both of Thorndike and of Kohler in terms of a single formulation which will have universal application to the learning process. It is suggested that this may be done in the manner indicated in the following hypothesis.

Statement of the Hypothesis

The following hypothesis is advanced: All alleged instances of insight learning are merely examples of trial and error learning plus the transference of past experience.- In other words, that behavior which has commonly been termed learning by insight is only the transfer to novel situations of solutions which have been acquired by previous trial and error. Two methods of study are proposed as a means of checking the accuracy of this hypothesis; first, the reviewing of the experimental literature on learning in the light of this hypothesis; secondly, the studying of learning behavior of various subjects in problem situations especially devised to test the validity of the hypothesis.

CHAPTER II

A CRITICAL ANALYSIS OF THE EXPERIMENTAL LITERATURE IN THE LIGHT OF THE HYPOTHESIS

Introduction

A review of the pioneer investigations basic to the contrasting theories of learning by trial and error and learning by insight has led to the statement of the hypothesis of this investigation, namely, that all instances of alleged insight learning are but the transference of solutions already acquired by trial and error to new situations. The first means of testing this hypothesis is to analyze critically representative investigations which interpret learning in terms of trial and error, and others which interpret learning in terms of insight.

Critical Analysis of Representative Investigations Tending to Confirm the Theory of Learning by Trial and Error

Following the publication of Thorndike's "Animal Intelligence," there were many experiments conducted on animal learning. Such studies as the following tend to give weight to Thorndike's con-

tention that all learning is by association and that various organisms differ only in the number and quality of the associations which they are capable of forming.

Yerkes and Huggins.- Experimenting with the crawfish in a simple labyrinth, Yerkes and Huggins (46) found that the crawfish was capable of forming associations; that is, could learn by experience, though very gradually. From fifty to one hundred experiences were necessary to cause a perfect association.

Yerkes.- Yerkes (47), experimenting on learning in the green frog, found that the frog was able to profit by experience on simple labyrinths. A few experiences sufficed for the formulation of simple associations, but in a series of associations from fifty to one hundred experiences were needed for the formulation of a perfect habit.

Colvin and Burford.- Studying the color perception of three dogs, a cat, and a squirrel, Colvin and Burford (9) concluded that the animals tested succeeded in arriving at the notion that a certain color, merely as color and apart from any particular setting was associated with food. But the animals possessed no initiative in the direction of abstraction, though they could be taught a rudimentary abstraction if conditions were artificially arranged.

Shepherd.- Shepherd (35) has studied the lower mental processes of the monkey by means of experiments on brightness discrimination, color discrimination, auditory discrimination, the formation and inhibition of habits, and retentive power. He studied the higher mental powers by means of experiments on learning by imitation, ideation,

reasoning, adaptive intelligence, and general notions. He concludes:

> Of the higher powers of mind the monkey has only rudiments. He has a something which corresponds in function to ideas of a low order and which serves practical purposes .... Two of the monkeys learned by imitation .... All the tested animals appeared to reach a generalized mode of action in dealing with problems but there seemed to be no evidence of true general notions. They have an adaptive intelligence, a lower form of reason, or a mental state inferior to true reason. (35:60)

Dennis.- Dennis (10), studying the learning of the white rat on three simple mazes which differed only in length, found that learning took place gradually. The first run of each rat on the initial problem was necessarily incorrect due to the nature of the problem. Following this first run the typical case of learning showed a series of consecutive incorrect runs, then a group of mixed correct and incorrect runs, then a group of the three consecutively correct runs called for as the criterion of learning. This grouping was only arbitrary and logical, however, as the progress from group to group was gradual.

Hunter.- Hunter (17) has studied the learning of a group of animals (rats, dogs, and raccoons) and children in situations where the determining stimulus was absent at the moment of the response. Associations were first set up between movements that led to food and a light which might be in any one of three boxes. Controls were used to make sure that the position of the light alone determined the reactions of the subject. Tests were then instituted in which the light was turned off before the reaction was made. The subject thus had to respond in the absence of the stimulus that hitherto had guided

his reactions. Hunter concludes that there are the following four grades of behavior:

> (1) The animal shows an absence of learning by experience. (2) The animal is able to profit by experience, but has no higher capacity than 'trial and error' or the 'stimulus and response' behavior would indicate. The rats and dogs of the present test come here. (3) The animal can learn by the trial and error method. Indeed, probably most of its reactions are upon this basis, being ruled by stimulus and response. But a new element now makes its appearance, viz., sensory thought, which is a representative function of strictly sensory content. The raccoons that I used are in this class .... (4) The fourth grade reveals the presence both of 'stimulus and response' behavior and of sensory thought, but added to these is the probability of directing reactions by images. The older children of the present tests very probably belong here rather than in the third class. (17:19)

The distinction which Hunter makes between the second and third grades of behavior in learning is as follows: In the second grade sensations initiate a correct response only when they have not been displaced during the interval of delay by other sensations of the same modality. In this grade of learning the orientation of the situation must not be disturbed. In the third grade of response the sensations can initiate correct responses even though they have been displaced during the interval of delay by others of the same modality. In this case the orientation of the situation can be disturbed and will be regained. It seems to the present writer that there is no fundamental difference between trial and error learning and the sensory thought learning or learning directed by images, except that the latter can make use of past experience more potently because of a higher neural development which makes for a more efficient memory.

Ruger.- Ruger (34) uses the terms "human" and "animal"

methods of learning as synonymous with learning by overt trial and success and learning by reasoning. He has analyzed the methods of human subjects in solving various types of complex mechanical puzzles. He found that the solutions were not the result of mere straightway thinking and the consequent formulation of a plan of action, but were the outcome of an extremely complex interrelation of more or less random impulses and of ideas. In a number of cases the solution came entirely by accident but the problem was complex enough that chance solutions were never immediately repeated. He concludes that these two methods of learning should not be considered as exhaustive of the forms of learning, but as two out of a larger and undetermined number. He found that humans learning puzzles behaved in the way usually ascribed to animal learning. The time interval on the trials often remained high and fluctuating. Acts which were obviously unsuccessful were repeated indefinitely and without modification, showing a lack of mental analysis on the part of the subject. In practically all the cases random manipulation played some part, and, in some cases, a very considerable part in the attaining of success. Ruger concludes:

> The reason for this similarity to animal methods seems to be that the functions tested were relatively poorly developed. The subjects could not mentally construct in any completeness the spatial transformations required. Discriminations were difficult, and there was no complete system of terms to stand for the discrimination when once made. The ideas with which the subjects sought to reason out the problem were not closely enough related to the case in hand to be of much value. Sometimes they were negative in eliminating useless lines of attack; at other times they seemed to be a positive hindrance to the solution. (34:9)

This lack of the ability to reason was undoubtedly due to a lack of past experience which was relevant to the problem. Reasoning was possible only with ideas. Ideas were possible only by means of past experience. Reasoning, then, is seen to be a function of past experience transferred to the situation.

Perrin.- Perrin (31) points out the necessity of past experience in reasoning in his experimental study of the human learning process in the maze. He says:

> The rational processes reported were unsystematic and seemingly futile. Adequate interpretations were suggested to the learner as the result of prolonged exploration, rather than reasoned out. Cues which logically should be utilized for correct inferences were disregarded, and ideas were acted upon in an uncritical manner until proven by trial and error to be incorrect. The explanation of the meagre attempts at reasoning is to be found in the fact that the learner had no past experience to apply to the situations, and in the fact that he was unable to select his data .... maze paths must be traversed in order. (31:95)

John C. Peterson.- Peterson (32) has used a simple game to study experimentally the human mental processes involved in the solution of novel problems and in the utilization of experiences so gained for the subsequent mastery of other problems of a similar nature. He concludes that trial and error is a universal method of procedure in learning of the problem-solving type. He says:

> Each stage begins with diffusion and multiple response and progresses through elimination and the preservation and gradual coordination of essential responses. Trial and error is the method of procedure in all stages, but the materials among which variations occur are somewhat different and the field of variation is progressively narrowed in the later stages. (32:103)

Peterson considers that the higher mental processes are not so much different in method from the sensori-motor learning process

but different in type and complexity of previously established interrelations of the materials to be organized. Frequency is considered the potent factor in the abstraction of elements. In the earlier stages of learning, those elements which occurred most frequently and in closest temporal contiguity were generally the first to be combined into higher units. Transfer was found to be by means of the specific associations between the symbols required for generalization and the elements of direct experience, which furnish the materials for generalization. The degree of transfer depended upon both the number and the strength of such associations as well as the degree of acquaintance with the elements of the problematic situation to which application was to be affected.

Harter.- Harter (13) has attempted to determine the ability of preschool children to solve a problem situation without overt trial and error. Children and adults were tested in three non-verbal performance tests, an obstacle peg test, a canal box test, and a pulley test. He concludes that pre-school children exhibit considerable overt trial and error in solving these problems.

Hull.- Hull (16), in experimentally studying the quantitative aspects of the evolution of concepts, concludes:

> The individual concepts usually come into consciousness very gradually. Erroneous first impressions are either discarded or transmuted into the correct form by a continuous development. Trial and error plays, if not a dominating, at least a very great role in the process. (16:85)

Joseph Peterson.- Peterson (33) has attempted to explore the alleged differences between the acquirement of skill in voluntarily

controlled acts on the one hand and learning by trial and error on the other. The learning situation is described briefly as follows: *

> On this sheet you will find the several letters of the alphabet each associated with the number written directly under it. The problem is to see how soon you can learn to give each letter immediately when its number is called .... You must keep this sheet before your eyes during the experiment, and must not respond in any case until you get the right letter. In case you make a mistake you must correct it at once, before the next number is called.

Peterson describes the behavior of the subjects in this experiment:

> When a number within the clear range of his vision was called, the response was quick and direct; but for other numbers the eyes made random exploratory movements here and there, often recurring several times to a given part of the sheet. As the localization of certain numbers became better established by the subject, these ocular movements showed less variability and they were more predictable; and they finally disappeared and became unnecessary as the association of the numbers with their respective letters reached an approximately automatic stage. (33:50)

Peterson's theoretical conclusions are well worth quoting:

> In all learning we shall probably find the sort of random, trial and error adjustment that is so characteristic of the acquirement of new sensory-motor controls, together with inhibitions and balancings of conflicting tendencies to response. The higher forms of learning adjustments, involving ideational activity, differ from the usual learning by trial and error in that in such forms the conflicts are among systems of acts already coordinated within themselves for fairly remote, far-reaching adjustments. At any rate, the present study, which is only in its initial stage, seems to indicate that with finer and finer criteria of errors applied to rational and higher forms of learning, random processes similar in essentials to the usual trial and error type will be found. (33:53-54)

Summary.- The experiments of Yerkes and Huggins, Colvin and

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* Adapted from Peterson's more detailed account.

Burford, Shepherd, Dennis, and Hunter all substantiate the theory of learning by trial and error. They reveal that learning takes place by the gradual modification of behavior during repeated presentations of the learning situation; that the subject finally makes the adaptive act providing it is within his capacity, but that success comes only after repeated trials during which behavior is gradually modified. Such learning can best be described as occurring by trial and accidental success or trial and error.

The investigations of Ruger, Perrin, John C. Peterson, Harter, Hull, and Joseph Peterson, indicate that the higher thought processes are the same as the overt in method; that is, mental learning proceeds by trial and error. Furthermore, these investigations reveal that such mental trial and error is dependent upon past experience with similar situations.

The advocates of the theory of learning by insight contend that there are facts of behavior in the learning process which the trial and error theory does not adequately take into account and explain. The experiments which tend to confirm this point of view will now be critically reviewed.

Critical Analysis of Representative Investigations Tending to Confirm the Theory of Learning by Insight

Yerkes.- Yerkes (48) studied monkeys and apes in certain problem situations with the aim of determining the existence or absence of ideas and the role which they play in the solution of problems. The most important experiments were carried on with an

orang utan, Julius, in a multiple choice situation. Julius was confronted with a series of rooms, a door opening into each. Food was in one of them. The wrongchoice was punished by imprisonment. Yerkes interprets a sudden solution, after a period of trial and error, as indicating insight. Here the term insight seems to be used as practically synonymous with ideational activity:

> The curve of learning plotted from the daily wrong choices .... had it been obtained with a human subject, would undoubtedly be described as an ideational, and possibly even a rational curve; for its sudden drop from near the maximum to the base line strongly suggests, if it does not actually prove, insight. (48:68)

In another multiple choice problem Julius failed to achieve solution. Yerkes explains this failure by saying that Julius was using ideation which in him was only slightly developed, while animals of lower intelligence using trial and error would have succeeded. Ideation and trial and error are thus given as two methods of learning, and insight associated with the former. Yerkes gives as evidences of ideation in the results yielded by the multiple choice method:

> (1) The use by the orang utan of several different methods in connection with each problem; (2) the suddenness of transition from method to method; (3) the final and perfect solution of problem 1 without diminution of the initial errors; (4) the dissociation of the act of turning in a circle from that of standing in front of a particular box. (48:131)

In number (4) of the above Yerkes refers to the fact that upon one occasion Julius turned in a circle before entering a room which was in front of him. The room proved to be the correct one. Then developed the habit of turning in a circle before entering any room he happened to be in front of.

Yerkes (49, 50) has also experimented with a gorilla in a variety of learning problems. The gorilla, Congo, was estimated at about five years of age when he began his series of experiments. The experimentation was carried on for three successive winters, approximately two months each time. During the first winter Yerkes set twenty-four problem situations which were logically classified into three groups: (1) the use of objects as appliances, as tools; the use of a stick to rake in food outside the cage, or the use of boxes to obtain food out of reach; (2) the manipulation of the environment in an adaptative way; and (3) problems whose solution involves a modification of the environment.

The work as a whole is too extensive even to summarize here, but one learning situation may be used for description and criticism. The use of boxes seems to be the best. In this problem food was suspended from a tree, out of reach. Two boxes were provided, being placed five feet off center under the food. The first three days of the experiment long trials were given during which Congo made no visible progress. Then on the four day,

> .... Congo took her position directly under the food and reached for it. Then she went to box 2 and moved it slightly toward the food; thence to box 1 on which she stood for a few seconds. Box 2 she now turned over with the open side uppermost. It was not more than two feet off center and quickly noticing its proximity to the food she mounted the corner nearest the food and balancing herself reached as far as possible. As her fingers touched the fruit she lost her balance and fell forward, her weight at the same time tipping the box over toward the food. Picking herself up she noticed the advantage thus accidently gained and mounting the box easily reached her reward. (49:108)

The day before Congo had, by others, been given the

opportunity to reach for a sweet potato and she had used a chair to help her. Yerkes suggests that this might have aided her in the solution. However, Congo had, in all probability, climbed upon other things to get what she wanted before this, those things being already in the proper place. This situation was a problem in that the boxes were not originally in a position to be of effective use. It was merely by chance that one of the boxes was gotten by Congo in the proper place. Congo was now tested on the four following days but seems not to have learned anything from this accidental success. Yerkes then proceeded to set for Congo an imitative copy of this problem. This continued for seven days, then,

> On January 29th the box problem was not presented, and on the 30th came a surprise. It was 9:20 a.m. when Congo was taken to the experimental situation. An apple had been suspended sixty inches from the ground and Congo as usual was chained to the stake while with my notebook I sat some thirty feet away watching. From the first she was alert and active, as if something of importance had happened since her last experience with the situation and she now came to it with a new hope and expectation of success. She went to box 2, mounted it, then to box 1 and stood on it; then returned and sat on box 2. Suddenly, and without visible warning she scrambled down from the box, seized it with both hands and carried it to a point almost exactly beneath the apple. Promptly she climbed upon it and easily reached her reward. This success required four minutes. There was no fumbling, nothing suggesting accident. Instead it was as though an idea had suddenly come to her and instantly became motor. (49:113)

Yerkes takes this as an evidence of learning with insight. Concerning the term insight he says:

> Insight is used throughout this report to designate varieties of experience which in us are accompaniments of sudden, effective, individually wrought adaptations to more or less distinctly new and problematic situations. (49:155)

The following criticisms may be made of this interpretation. Congo's solution of this problem was sudden. In fact it could not

have been otherwise by the very nature of the problem. What Yerkes means, however, is that in the solution there was no trial and error activity. What he does not take into account, though, is the extremely large amount of such activity which took place on the many days before and which was furnishing Congo with experience which would make ideational activity possible. Certainly it would be hard to say that Congo's solution was "individually wrought" in view of the imitative copy set for her in the many days before. We may even question whether the problem situation is "distinctly new" at the time of the solution since there had been so much random and trial and error activity preceding that solution. This trial and error activity had given Congo experience with the different phases of the situation. The solution was a product of trial and error activity which resulted in the gradual accumulation of experience relevant to the problem; the sudden transference of that experience and the resulting sudden solution being a function of the nature of the problem itself.

Yerkes classified the types of learning behavior exhibited by Congo as:

> (1) Adaptation based upon reflex or automatized simple or complex acts, the elicitation and repetition of which in a given situation yielded satisfaction in the form of freedom, food, or other desired objects or opportunities for activity. (2) Adaptation resulting from what to all appearances is random trial of different activities and the ultimate discovery and, finally, regular repetition of the particular act or succession of acts which yields satisfaction .... (3) Differing from (2) in directness and possibly also in the nature of the neurological processes is a form of adaptation which involves inspection of the situation, with resulting exclusion of certain obviously possible acts and the limitation of trial to certain modes of response which more or less closely approximate adequacy. Finally, from among these acts, one which is not necessarily the most nearly adequate of all, but as a rule is highly adapted, becomes the

preferred and regular mode of response. This variety of adaptation involves not only observation but discrimination and selection on the basis of previous experience. (4) Adaptation with insight appears as a step in advance of method (3) for in it the organism, following observation of the problematic occurrence or use in the absence of previous familiarity with the situation, indicates at least observational appreciation of some of the essential relations of the problem. In the previous mode of learning there is a measure of insight or an approach to it, but in the present mode insight is the conspicuous and all-important feature .... (5) So often do combinations of these modes of adaptation appear that it would be inexcusable to omit the category of mixed response. The use of automatisms, process of trial, inspectional analysis with a measure of insight, all may appear in the solution of any given problem. (50: 505-506)

Yerkes mentions the "slot box" experiment as giving the best evidence of insight. This experiment may be critically reviewed. The apparatus used was as follows: *

A wooden box 72 inches long, one end of which was closed, the other end open. On both sides and on the top of the box were cut slots in the following manner: slot 1 on the one side of the box began at the closed end and extended twenty-four inches toward the open end; slot 2 was located precisely in the middle length on the top; slot 3 was located on the other side, and began at the open end and extended for twenty-four inches toward the closed end.

Food, placed in a milk bottle from which Congo had previously secured food in other experiments, was placed at the closed end of the box. The bottle could be moved toward the open end and there secured by using the hands at the various slots. The following is Congo's learning behavior in this problem:

Congo watched me place several pieces of banana in the milk bottle and push it into the box. She was then moored to the slot box stake with the following result. Directly she went to the open end of box and looked in. Then she ran to the closed end and through slot 1 observed the bottle. Immediately she began to work for it, using both hands to try to pull it through the slot, the latter being just wide enough to enable her to get her fingers and part of the palm of the hand through. After a few seconds of vain effort to thus obtain the food, she desisted and going to the open end again looked

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* Adapted from Yerkes more detailed description.

in. Then she went to slot 2 and looked through it. Then away from the box for a few seconds. Returning she stood at the open end and pounded the box hard with both hands. Next she ran to slot 1 and sitting down before it worked at the bottle with both hands, but especially with the right hand, evidently trying to get it through the slot. Again she left the box for about a minute and occupied herself with a root in the ground nearby. Returning to the open end of the box she lay down in front of it and felt around beneath the box, as though searching for an approach to the bottle. Shortly she returned to slot 1 and began moving the bottle with her right hand. Presently she happened to move it toward the open end of the box. Instantly she perceived her advantage, gave a growl of surprised interest, ran to the open end and looked in. Then she ran to slot 2 and reaching in was able to touch the bottle and to push it still farther toward the opening of the box. Once more returning to the opening she reached in and obtained the bottle. (50:426-427)

Let the fact be noted that Congo was allowed to see the bottle placed in the open end of the box and pushed to the other end. It is difficult to ascertain how much Congo might have been aided in her solution by this experience, since we know so little concerning learning by imitation in animals. But it is not too much to suppose that Congo, before being allowed to work at the problem, had observed that the bottle went in at the open end, and that that would be the place to get it. Naturally Congo went immediately to that place. How much Congo learned by observing the experimenter push the bottle in, which might be imitated in pushing the bottle out, is again difficult to ascertain. The problem would be much more convincing, however, if Congo had not witnessed the setting of the problem. Certainly there can be no doubt concerning the trial and error and even random activity. Even after experience should have taught Congo that the bottle could not be gotten through the slot, she still tried to get it that way. The first pushing of the bottle toward the open end was a matter of

chance in the course of trial and error activity. "Presently she happened to move it toward the open end of the box." To this point there were only two elements in the learning behavior: trial and error activity and chance. But, having moved by chance the bottle closer to the open end of the box, Congo perceived the advantage gained and went to that end and looked in. Congo's previous experience at that end had taught her that the bottle was out of her reach. When the bottle was accidently moved closer to that end Congo immediately realized that it would be closer to her reach. Such spatial discrimination was merely a product of past experience in her manipulation of other things. Acting on the basis of that past experience Congo went immediately to slot 2 and pushed the bottle closer to the opening. It may be concluded that the learning acquired by trial and error activity and chance at slot 1 was transferred bodily to slot 2 (both slots being exactly alike except that they were located on different places on the box). It seems again that insight as a mode of learning is nothing more than the transfer of past experience, which past experience had been gained by trial and error activity.

Bingham.- Bingham (4) following the method used by Kohler and Yerkes, has studied the learning behavior of chimpanzees in the use of boxes as means of getting food. He gives the following as criteria of ideational behavior manifest in his subjects:

> Outstanding adaptations, that seem to belong in the general class of ideational behavior have been described under the following terms: (a) abrupt changes; (b) reflective pauses; (c) anticipatory looks; (d) confluent acts; (e) transfer of skill and plan; (f) overnigh solutions; (g) transformation as revealed in corrective adjustment. (4:56)

Bingham concludes that there is little involved in insight behavior that is strictly new. He says that the adaptive novelty in insight behavior is probably to be found in the new focus of response factors. This would seem to lend evidence to the fact that insight may be merely the transfer of past experience, or the solution of the problem on the mental level as made possible by that transference.

Bingham (5) has also studied selective transportation in the chimpanzee. In this study the author uses the terms insight and ideational activity as practically synonymous. He says,

> This whole study of adaptivity in transportation and translocation was undertaken as an approach to the general problem of ideational behavior. My task was primarily to get facts which might be useful in defining insight if such behavior should be found. (5:2)

The behavior of chimpanzees was studied in situations where the chimpanzees had to overcome some barrier in transporting the object to the goal. A simple illustration of this behavior is when the chimpanzee bends a limb down so as to reach the fruit with the mouth. For the experiments a more complicated situation was provided by the following apparatus: *

> A metal cage six feet square and three feet high was constructed. There were small openings on all four sides. These could be closed. The top was divided into four equal sections by a channel. Two pool balls were turned so as to fit, one on the bottom and one on the top, fastened by a bolt, in this channel. From this

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* Adapted from Bingham's more detailed discussion.

device was suspended food inside the cage by means of a cord. One of the openings was left open and the others closed. In order to get food the chimpanzee had to learn to slide the pool-ball-mechanism along in the channel until the food was within reaching distance from the unobstructed opening.

Bingham gives the following as pertinent to a definition of insight (5:42-45): *

(1) Experience: crucial experience must be acquired with the solution, not transferred from past experience in previous situations. (2) Versatility: (a) General inspection of the problem situation; (b) Abrupt changes in behavior: in eliminating errors, in changes from activity to pause or from pause to renewed activity; (c) Sudden initiation: period when behavior appears inspired. This is indicated by changes in facial expression; (d) Correction of errors: accidental errors made when subject was working definitely toward goal, which errors were immediately corrected in order to reach the goal. (3) Consistent orientation: subject used many different methods of manipulating the mechanism in the experiment; such as, use of different hands, pushing or pulling, carrying or rolling. All this varied behavior was directed toward the one goal. (4) Anticipatory response: subjects demonstrated by their behavior that they anticipated the result of their actions; such as, preparedness in advance of arrival at the correct terminal for going to the goal and taking the lure. (5) Representative behavior: (a) Subordination of the final step until a preceding stage is reached; (b) Pursuance of

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* Adapted from Bingham's more detailed discussion.

a roundabout course. (6) Sudden change in time curve. (7) Selection of goals; when a new goal was introduced after successes at two or three different goals, readjustments were demonstrated by transportation only to the appropriate terminal. (8) Fluent solutions: An organization of disparate factors of response in the absence of specific experience in the necessary performance. Such reorganization of responses may follow explorations, visual and tactual, of the situation and are to be classified as planning behavior.

In reference to (1) above, the subjects had previously gotten acquainted with the cage and food in it. The one thing that had to be learned by them was to move the mechanism so that the food could be reached. That the mechanism itself would move had to be learned by chance. It is true that there was no past experience from previous situations which would help the champanzee in moving the mechanism to the proper place. However, the chimpanzee did acquire that necessary experience in the course of random and trial and error activity in the earlier portion of the experiment. In respect to (2), (a), (b), and (c), such behavior seems explainable on the basis of mental trial and error activity. In "the general inspection of the problem" the subject is merely "sizing up" the situation in terms of his past experience. Item (2), (b) is presumably indicative that mental activity is going on during the pause. The inspiration in (2), (c) is certainly not to be thought of as a direct revelation from the chimpanzee gods, but only as the hitting upon a probable solution in the course of mental trial and error activity, during which the subject is canvassing

his repertoire of past experiences. In (4) the question may be raised as to how the subject can have foresight of the consequence of his acts except on the basis of past experiences. Certainly (7) is simply the transfer of past experience to an almost identical situation. In regard to (8), in the complete absence of past experience, if the subject solves the problem immediately it must be assumed that he solved it either on the basis of instinctive behavior, or on the basis of innate ideas, or by chance. However, in the cases cited in the experiments, a period of exploratory behavior preceded the solution and gave the sufficient experience needed for solution, chance playing a significant role. Unless one is willing to accept the doctrine of innate ideas, the conclusion is forced that purely mental exploration is impossible in the absence of past experience relative to the situation.

McDougall.- McDougall (25) considers that insight is not sufficient to explain all learning and supplements it with the concept of foresight. Experimenting with a monkey learning to open a puzzle-box, the lid of which was fastened first by one latch, then the addition of other latches one at a time, he describes the behavior:

> Dee, approaching the latched box for the first time, tries in vain to push up lid, moves L 1, after a few seconds, opens and secures food .... L 2 added, locking L 1. Dee goes to L 1 at once, fumbles, moves L 2 and L 1, and opens .... (25:247)

Both trial and error activity and chance are apparent in the above description, as well as transfer of experience from the trial with latch 1 to the trial with latch 1 and latch 2. McDougall says:

> The marked increase of facility in dealing with new latches resulted from Dee's experience in opening the earlier members of the

series. (25:255)

McDougall contends that not only insight (the grasping of essential relations, such as those of time, space and causation) is needed, but also foresight, foresight of relations, not yet realized or presented, but to be realized by the agency of the movements which the animal is about to make. This differentiation between insight and foresight appears to be an arbitrary one, and one which the insight psychologists would not accept. To the insight psychologists the subjects perceiving of a relationship between himself and a goal, involving the means of reaching that goal, includes foresight; that is, the subject sees his acts in relation to their consequences. But from the viewpoint of the hypothesis which has been suggested, foresight is possible only on the basis of past experience.

Smith.- Smith (36) studying the human reactions in a maze situation contends that the usual construction of the maze has precluded any other method of learning than learning by trial and error. He constructed a maze so as to permit the use of the eyes for a limited view of the maze at one time. He gives the fact that ninety per cent of the subjects stated a definite reason for starting around a circular maze either clockwise or counter-clockwise as indicating insight, because these subjects reacted to the maze problem as a whole rather than by part responses. But is not this merely a product of past experience? Certainly no trial and error advocate has ever said that a subject always reacts to a problem in an absolutely random manner. The subject always reacts to a problem first in terms of the

instinctive and habitual responses which it brings to the situation. In this case the subjects had developed a clockwise habit. Some few, thinking that the maze would be the opposite from the obvious, chose to go counter-clockwise. But they acted no less on the basis of their past experience - their past experience with clockwise movements as the usual way of going around circles and their experience that problems are the opposite of the usual or obvious. Smith further says:

> Aside from the beginning with a clockwise movement a majority of subjects reported that the first trial was largely of the random trial and error type. After the first trial only a small number reported trial and error as the chief method of learning while a large majority explained the elimination of errors by a rational method .... (36:404)

A more fundamental statement may well be that the rational method used in later trials was made possible only by the experience gained in the first trial - the trial which was largely trial and error. Furthermore the question may be raised whether it is possible to have mental solution of a problem where all the aspects of the problem are new. Smith gives again as a criterion of insight:

> The individuals tend to react to the maze as a total situation and therefore with insight. (36:404)

Just what is meant by this is not altogether clear. What is probably meant is that the subject had a plan in mind for attacking the problem, and that therefore the solution was mental rather than overt.

Hsiao.- Hsiao Hung Hsiao (15) has studied insight behavior in rats within a spatial complex. He uses the term insight, as he

interprets it from Kohler's usage, as the ability of grasping a material, inner relation of two things to each other. He constructed a simple maze consisting of three alternative routes to food. Routes 1 and 2 converged into a common pathway at a door behind which was food. Route 3, which was a longer and more roundabout way to the same food, had a separate door entrance. After training rats to run all three routes, the common door at the end of routes 1 and 2 was locked. The problem was to discover whether the rat could acquire insight into the fact of the final common pathway of these two routes when these pathways were "bad." When this common doorway was locked would the rat, after arriving at the locked door by route one and retracing to the beginning of route 2, go then immediately to route 3. Only two rats chose route 3 immediately after finding route 1 "bad." However, Hsiao concludes that the rat's behavior is unexplainable in any terms other than those of insight. He gives as the reasons: *

> (1) It is impossible to account for the more often choice of route 3 by distance to food, since route 3 is farther than route 2; or by frequency, for the rats had received more training on route 2; or by recency, for in the order of training in the alternate series, route 3 was less recent than route 2. (2) It is impossible to regard such responses as natural since the rats showed preference for route 2.

Here again the question arises as to whether the term insight is not a name for something which is better explained by the transfer of past experience. The rats had, by a number of trials, learned that routes 1 and 2 ended at the same door, while route 3 lead to a different

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* Adapted from Hsiao's more lengthy discussion.

door. This was all done before the problem as such was presented. In the solution of the problem all the rats had to do was to make use of that past experience.

Maier.- Maier (23), studying reasoning in white rats, set as his problem that of learning whether or not rats can solve problems without trial and error; that is, can a rat, placed in a certain situation, adjust itself intelligently or adequately for its purpose, without previously having learned to respond in the situation concerned and without making a series of random responses that finally lead to an adjustment. The term insight is used in the sense given it by Kohler. Interpreting Kohler's method of studying insight, he says:

> His method of "roundabout ways" to food presents the animal with problems in which there is a chance for intelligent solutions. The animal is allowed to become familiar with the whole situation and thus is able to apply its knowledge of that situation to the problem in an intelligent manner. (23:3-4)

In accordance with this concept of insight, Maier devised various situations, with the several phases of which the rats were made familiar. The problem was to see whether the rats could combine these past experiences into a continuous whole so as to react to the situation without trial and error movements. The following is a brief description of one of these situations: *

> A cardboard barrier divided a table into halves. A wire food box was placed at one corner of the table, the entrance of which was impossible from that position. The food box could be entered only

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* Adapted from Maier's more detailed description.

by scaling the cardboard barrier, going to another corner of the table and running a maze which led from the table to the food box back at the opposite table corner. The rats were first made familiar with the table, including the scaling of the barrier. They were then made familiar with running the maze. Then they were placed on the table in front of the food box and their behavior observed. Maier held that if the rats made use of their past experience, that is, their familiarity with the table and the maze, thus connecting the two experiences together and going immediately in a direct route to the food, they acted with insight.

The rats having fulfilled this criterion to Maier's satisfaction, he concludes:

> Rats can combine the essential relations of one situation with those of another in such a way as to reach the goal which could not be reached by any one concrete experience. They can adequately adjust themselves to a new situation without "trial and error," but with intelligence and insight. The solution is a continuous whole and is directed toward an end. (23:88)

But in this experiment Maier recognizes the fact that insight is possible only upon the basis of past experience which can be transferred to the situation. That past experience was originally learned by the rats in a purely trial and error way. The only problem in the situation was that of connecting these past experiences together, which the rats did. Maier might contend that transfer of experience was a criterion of insight. But the question might be raised; is insight anything else than the transfer of past experience which has been originally learned by trial and error activity?

Perkins and Wheeler.- Perkins and Wheeler (29), and later Perkins alone (30), have studied insight learning in the goldfish. In their experiments they found the goldfish able to chose food from three absolute light-intensities changed in position, and also able to choose a light in relation to two others, when the absolute intensities and positions were changed after each response. This transfer

was made without added training when the light intensities were transposed both up and down the intensity scale. They hold that the results of their experiments demand an interpretation in terms of insight rather than trial and error. Insight is interpreted in these experiments as follows:

> By insight is meant (a) transposition of the general properties from one situation to another, (b) response to a complex, total situation the details of which have been altered without changing their relationships in the total structure, (c) response to parts in the light of the whole, (d) configurational or structural response, (e) reacting to a complex situation in a way that might be called adequate or sensible. (29:535)

In (a) and (b) above, transfer of experience seems to be used as a criterion of insight. Experience which has been gained by trial and error learning is transferred to another situation thus making trial and error activity in the latter unnecessary. In regard to (c) and (d) we may raise the question as to whether there is anything here which cannot be adequately explained by trial and error learning plus transfer of experience. In (e) the solution of the problem itself is taken as a criterion of insight; presumably the problem is considered beyond solution by trial and error learning. These experimenters further say:

> In the learning process the animal responds to the pattern which it sees, in the light of the insight which it possesses. This response involves a perception of the goal in its relation to the total situation. Insight in the fish developes, we may suppose, as the result of a maturation process; thus the animal can respond to a gradually more complicated stimulus-pattern. (29:43-44)

This interpretation may be readily criticized. The animal responding "in the light of the insight which it possesses" is equivalent to saying that it is responding in terms of its past

experience. Again, insight developing as the result of a maturation process is identical with the accumulation of experience by trial and error activity.

Adams.- Adams (1) has conducted a series of experiments using cats in three of Thorndike's puzzle boxes. He found much less random activity and more time spent in looking over the situation, than did Thorndike. First the problems were solved by accident but this was attributed to the design of the boxes which precluded any other solution. He concludes that learning cannot correctly be described as gradual elimination of errors. Adams also conducted a series of experiments in which cats had to learn to operate levers of various types, pull strings, respond in delayed reaction situations, and use a box as an implement to get suspended food. He generalizes the behavior of the cats in the following way:

> (1) There is a cat .... (2) There is something the cat wants .... (3) There are .... things which may be such as to facilitate or to impede the cat's getting what it wants. (4) In one way or other, after certain movements with respect to the situation and the thing wanted, the cat gets what it wants .... (5) There is the cat again. (6) There is something the cat wants. (7) There is another situation, more or less like the first .... (8) The cat gets what it wants more readily than it did before, that is, with greater economy of movement .... If economy is small, it is often called trial and error learning. It might also be called insight, or a big insight, or mental trial and error .... (9) Sometimes the situation is not very like any one earlier situation but is more or less similar to a number of earlier ones. (10) Under these conditions the cat sometimes gets what it wants very suddenly, and with great economy of movement, after a period of no evident progress. (11) Thereafter in situations very similar to this last one the cat uniformily gets what it wants with great economy of movement. These last two phenomena are often called insight behavior. (1:155-157)

In the light of the hypothesis of this investigation this

interpretation may be criticized as follows. In (8) above the difference which is made between "a small insight" and a "big insight" is merely the difference between a small amount of transfer of past experience, and a large amount of such transfer. If the transfer is large, then there is a "big insight," or "mental trial and error" is made possible. Insight, then, is only a function of the transfer of past experience to new situations. In (9), the "biggest" insight possible, there is still the situation "more or less similar to a number of earlier ones." The question arises: is sudden solution in a complex problem possible except upon the basis of a great amount of transfer of experience?

Alpert.- Alpert (2) has studied the solving methods of pre-school children in problem situations like those used by Kohler in his experiments with chimpanzees. The responses of the children to these situations are described in terms of their types: *

(1) The primitive response. Reaching directly for the objective with the hand. (2) The random response. Corresponds with the reactions exhibited by Thorndike's cats. The emotional tone and tempo of activity is the characteristic feature of this response. (3) Exploration and elimination. This refers to a deliberate trying out of one possibility after another or an investigation of the constituent parts of a situation. (4) Immediate solution. This refers to immediate solution where no problem seems to exist or sudden solution after a brief interval during which the primitive response is dominant.

Alpert defines insight in her problem-situations as:

If the subject used the stick or block as a means for the objective as the end, then it may be concluded that the subject saw

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* Adapted by the writer from Alpert's more lengthy discussion.

the relatedness of parts, that is, stick or block, objective, and himself, constituting the whole .... desired objective out of reach but attainable with the help of the stick or block. In other words, the solution is accompanied by insight. (2:36)

Since the problems were so devised that they were beyond solution, from Alpert's viewpoint, until this relationship was perceived, solution itself became the criterion of insight.

In fact, the set-up of the problem-situations is such as almost to preclude any other solution, however likely to occur such solutions are in puzzle-box or wire-puzzle type which allow the factor of chance greater play. (2:38)

Since the problems were solved by most of the subjects Alpert dismisses the problem of whether or not insight was present and devotes the study to the question of how insight evolved. The types of solutions, or types of insight, are then classified as:

(1) Solution with immediate insight; that is, the problem was solved immediately, as no problem seemed to exist. (2) Solution with gradual insight: (a) Partial insight: insight maturing gradually but never becoming complete even after the solution. (b) Complete insight: insight maturing gradually but becoming complete. (3) Solution with sudden insight: (a) Maturing during exposure to the problem: solution preceded by a period of exploration and elimination. (b) Matured between exposures. (2:41)

The question may be raised as to why no problem existed in the case of (1). If the situation presents no problem, then it is either solved by instinctive activity, or by chance, or on the basis of past experience (unless we wish to grant the validity of innate ideas and say the solution existed in the mind a priori, of experience). Since the problems were obviously beyond solution instinctively and since we are not willing to grant the presence of innate ideas, the lack of a problem can be interpreted only in terms of chance solution or past experience which the subject brought to the situation. But

most likely the subject had never solved a problem just exactly like this one before. What he had solved was a problem, or many problems, much like this one. This past experience gained with a like problem, or problems, limited the need of exploration, elimination, and random behavior. Yet, if the problem can be said to be new in any sense of the term, there was something to learn. But this "something to learn" was extremely simple in the case of the immediate solution, learning taking place by means of a rapid reorganization of past experience and application of that experience to the problem at hand. But, even then, the first response was a trial. Here was a situation much like the past solved ones. But since it was somewhat different the subject could not know conclusively that the trial would be correct. The fact that the first trial results in a solution does not make it any less a trial, or the learning any less trial and error, or trial and success, learning.

In the case of solution with sudden insight maturing during exposure, (3) (a), the subject did not possess sufficient past experience to solve the problem immediately. But the period of exploratory activity provided that experience. In many such cases it may be that the subject was merely slow in associating this problem with past experience.

In the instance of sudden solution where insight was supposed to have matured between exposures, (3) (b), such solution may have taken place by means of mental trial and error activity during the interval. The subject can be taken from the situation but the situation

cannot always be taken from subject. Again, the experimenter cannot be sure what relevant experience the subject may have gained during the intermission (the children being tested on the same test on various days). Again, the experimenter cannot be sure how much the children in this nursery shared their experiences with one another.

It seems that the learning behavior in these experiments can be adequately and more simply explained by means of trial and error activity (or as Alpert calls it: primitive response, random response, and exploration and elimination) combined with the transfer of experience thus gained.

Alpert, quoting Koffka, considers that chance is secondary to insight.

> To sum up this question of the role of chance in solutions, it may therefore be said, that chance may be instrumental in bringing about an optimum constellation of the elements of a problem-situation, and that this constellation may or may not arouse insight. But unless insight is aroused, the most favorable constellation may go astray and the problem remain unsolved. (2:50)

By the hypothesis which has been laid down, what is termed insight in such instances is nothing more than the transfer of past experience. The subject reacts in a more or less random manner. Suddenly those random movements result, quite unintentionally, in bringing the subject, the goal, and the means into a suggestive relationship. The problem is solved by acting upon the suggestion. But what made the relationship suggestive? Would it have been "suggestive" had not there been past experience aroused by the new chance aspect of the situation? Thus, when these past experiences are lacking, or for some unknown reason they fail to be aroused, "the most favorable

constellation may go astray and the problem remain unsolved."

Wilmoth.- Wilmoth (45), experimenting with white rats, children, and college students, has made a comparative study of trial and error and insight learning. The gaining of the concept of middle-sizedness was used as the problem. Wilmoth concludes that insight and trial and error are two types of reactions, but neither can be sharply distinguished from the other; instead, one supplements the other in any complex learning situation.

In summary the problem situation used with the college students may be briefly described. *

In the trial the subject was confronted with three numbers, a constant difference being maintained between the first and second and the second and third. The numbers were so chosen that in a group of three numbers all the numbers were either odd or even. In this manner was formed a learning series consisting of two hundred and ten groups of three numbers each. An apparatus was constructed for presenting a group of the numbers for each trial. The subjects were told to pick out a number on each trial. They were instructed that one number was always right. They were to guess. They were to continue this until they had picked ten right numbers in succession.

In interpreting the learning results Wilmoth says:

From the above data one sees the two types of behavior present in about equal amounts until the relationship is seen. After this insight plays the dominant role until the criterion is reached. (45:115)

But did not the nature of the problem situation force trial and error activity? The subjects were told to guess. The statement that the subjects met the problem in utter ignorance (45:104) is certainly not to be taken literally. Being forced to guess, thus

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* Adapted from Wilmoth's more detailed description.

forcing trial and error activity, the behavior was merely a matter of trying out all the possible reactions which made up the repertoire of past experience. Take, for instance, the following:

> Number 2. "I guessed first the highest number and then the lowest. When both were wrong I chose the middle number which was correct. After finding the way of doing it, I still made errors by not observing carefully enough. (45:115)

There was nothing else for the subject to do in this problem-situation than to "try, try again" in terms of past experience. Even if the first "try" had been correct and immediately followed up, it would still have been trial and error, or better, trial and accidental success, activity. When in the course of such trial and error activity, a certain "try" proves correct and is immediately retained, one may question why it should be called insight as distinguished from trial and error learning. Wilmoth considers that it is insight learning because it is sudden learning:

> In each case the change in behavior came suddenly, that is, the solution was seen at once, and in this we have evidence of insight. (45:115)

However it appears that learning would take place suddenly by the very nature of the problem. There was only one element for the subjects to learn and that element could not be learned in any other way than suddenly; that is, in the course of the "try, try again" activity, each "try" was sudden, therefore the correct one sudden. Naturally when any one certain "try" was announced right it would tend to be repeated until called wrong. Wilmoth gives as another criterion of insight the following: if any subject formulated a plan and acted in terms of that plan, then that indicated insight. But the subjects were told that one of the numbers was right. In terms

of their past experience they would naturally have supposed that there was a plan. It is unnecessary to call the activity of trying to find this plan by the term insight when it can adequately and more simply be described by trial and error and the transfer of past experience.

Yerkes, many years before, had pointed out that in some learning situations both trial and error and insight activity were present (see item (5) of types of learning behavior exhibited by Congo, pp. 28-29). Yerkes' most probable answer to Wilmoth would be that her learning situations were so devised that a mixture of these two types of learning was inevitable, but that had the situations been different only insight behavior would have been present. At least, from the viewpoint of the present writer, it is not a question as to whether or not overt trial and error activity is present in some learning situations, slightly present in others, and totally absent in still others. This is a well proved fact which can easily be seen from the review of the experimental literature on learning. The crucial question is: when overt trial and error activity is absent is this a valid criterion of insight learning, or can such be explained by the trial and error theory with the aid of the transfer of past experience?

Again, it is not a question as to whether learning in some situations takes place immediately, and in other situations suddenly after a period of trial and error activity. This, too, is a fact beyond question. But the significant question is: when learning does take place immediately or suddenly, are these valid criteria of insight learning? Does such learning behavior ever take place in the absence

of relevant past experience which has either been gained before meeting the situation, as in the case of immediate solution, or during the earlier stages of trial and error activity in the situation, as in the case of sudden solution? Or phrased differently; is there any behavior in the learning process which cannot be explained by trial and error activity with the aid of transfer of experience, which past experience has originally been acquired by trial and error?

At this point it seems advisable to summarize the various alleged criteria of insight learning prerequisite to the experimental testing of the hypothesis of this investigation.

The Alleged Criteria of Insight Learning

Immediate Solution.- One of the criteria concerning which these two theories differ is that of the time interval involved in the learning process. According to the theory of insight, if the solution of the problem is within the capacity of the subject, learning should take place immediately. Wheeler gives this as one of the criteria of insight:

> Consistently responding to novel aspects of situations correctly for the first time. The use of a new tool in arriving at a goal; the use of new words and phrases correctly in novel situations; invention. (43:519)

Yerkes gives this as a criterion (see quotation, p. 20) as does Alpert (see number 4, p. 38).

On the other hand, Carr, an advocate of trial and error learning, holds that learning in any complex situation takes place gradually:

Learning may be defined as a process of modifying or reorganizing our customary modes of procedures in such a way as to enable us to react successfully to novel situations. No complex act is ever learned at once. Beginning with our congenital repertoire of movements, each complicated act is regarded as having a long and complicated genetic history. (6:101)

Thorndike likewise holds that learning is a gradual process of stamping in right acts and stamping out wrong ones. (See p. 6)

Wilmoth concludes from her study:

In the first place "sudden" meaning immediate solution as soon as the problem is presented, means that there is no problem, hence no learning takes place. The experimental findings of this study point to the fact that where the solution is virtually known as soon as the problem is presented, there is in reality no learning. Behavior enacted in such situations demonstrates neither insight nor trial and error behavior; rather a series of responses already known and already organized. (45:124)

But the question may be raised: what is it that makes it possible for solution to take place immediately? Certainly if the situation can be said to be new in any aspect, then that aspect is learned, even if it is learned immediately. Sudden learning does not mean no learning. The time interval involved does not determine whether learning takes place; it merely describes one phase of how learning takes place. It seems more probable that immediate learning is a function of the transfer of past experience.

Absence of Random Activity.- The insight theory, holding that learning should take place immediately, has no place for random activity. Wheeler says:

A random, or trial and error method, of attacking any problem, is unnecessary and wasteful. When an animal or human being adopts such a method it is obvious that the problem is too difficult to fit the subject's level of insight. A new situation should be met successfully the first time. Where learning or mental development of any kind is involved, the problem should be simple enough at the outset to permit an immediate solution; the next time the problem

is presented it can be made a little more complex, yet it will be solved immediately without a random procedure. (44:115)

Wheeler holds that the subject's random efforts are random only in respect to an incomprehensible goal imposed upon him. When such is the case the subject creates goals of his own and his reactions with respect to those goals are never random.

But Pechstein gives as the first stage in trial and error learning:

> Random, excess activity. This stage shows the typical breakdown in the control of a situation, and is characterized by random spontaneous movements and ideas not necessarily or immediately related to the solution of the situation confronting the learner. (28:73)

Carr defines such random activity from the trial and error viewpoint:

> Organisms exhibit a random and unsystematic mode of attack only in the sense that the exact order of procedure can never be predicted. (6:89)

The question may be raised: why is there random activity sometimes and not at other times? Alpert has pointed out that the presence of random activity is a function of the nature of the problem situation itself:

> In showing that the same child varies his response from more or less random manipulation to more or less deliberate experimentation in accordance with the set-up of the problem, it places emphasis on the problem rather than the subject. This is confirmed by the results of Ruger's experiments with wire-puzzles which show that intelligent adults may respond in a manner formerly considered typical of animals, if faced with problems obscurely organized. In other words, whether the subject be an animal, a child, or an adult, different types of response may be provoked by changing the set-up of the problem. (2: 32-35)

But what makes a certain problem situation "obscurely organized" for a particular subject? It seems highly probable that

such is a function of the subject's lack of past experience with this or similar situations. Random activity, then, is a function of the newness of a situation while lack of such random movements is a function of the transfer of past experience.

Absence of Chance as a Primary Factor.- The two theories differ also concerning the role which chance plays in learning. According to trial and error learning the solution comes first by chance. (See Thorndike, p. 6) But if the learning act is complex, the chance solution is acquired only gradually (See Ruger, p. 15). Pechstein says:

> Whether the learning is on the motor or the ideational level, the learner seems to stumble upon the adaptive activity, and may properly be said to have learned by "trial and error." (28:74)

Such chance in the learning process is defined by Carr:

> The discovery of the solution may be characterized as a matter of chance only in so far as the time of its occurrence can not be predicted. (6:90)

But Koffka holds that although chance and insight are not opposed to one another, for insight frequently comes through the employment of chance, yet insight is prerequisite and fundamental. He says:

> Instead of the solution arising first by chance, and thereafter becoming more or less "understood," understanding, or an appropriate transformation of the field, precedes the objective solution. (18: 205)

These two theories are seen not to differ concerning the presence of chance in the learning process, but as to the part which it plays in learning. The trial and error theory assets that the adaptive act comes by chance in that its coming is not predictable.

The opposing theory contends that before the adoptive act appears insight must have preceded. In the light of the hypothesis of this investigation it appears highly probable that the only thing prerequisite to chance is past experience with a like situation which the chance act brings about.

Sudden Learning.- Where the situation is complex enough that the subject cannot solve it immediately, yet the solution is within the capacity of the subject, the insight theory holds that the learning act will appear suddenly. Wheeler gives this as another criterion of insight.

> Sudden formation of configurational responses. Rapid rises or falls in the learning curve, depending upon the fashion in which the curve is plotted; sudden solving of problems when responses were previously controlled by chance distribution of conditioning factors; sudden elimination of long routes to the goal; sudden abandoning of wasteful procedures. (43: 519-520)

Yerkes likewise gives as a criterion of insight:

> Appearance of critical point at which the organism suddenly, directly, and definitely performs required adaptive act. (50:156)

Koffka also says:

> To be sure, a true solution often follows after a perplexed period of trial and error; but in this case the difference is even more striking, for the animal suddenly gives a start, stops a moment, and then proceeds with a single impulse in a new direction to the attainment of the goal. (18:181-182)

But in this instance, as in the case of immediate learning, the advocates of trial and error learning contend that learning will take place suddenly only in very simple situations, that is, simple from the viewpoint of the learner. Carr is representative of those holding this view when he says;

> The correct response is fixated and the wrong acts are gradually eliminated during a series of repeated trials. (6:92)

We have already noted certain situations which by their very nature force sudden solution (see pp. 43-44). But in those situations which do not of themselves force sudden solution, what is it that makes for learning in that manner? The simpler and more adequate explanation would be that sudden solution is a function of the gradual accumulation and transfer of experience gained by trial and error activity; the fusion of such experience in the solution coming suddenly. Even then it may be that the sudden fusion of such experiences is largely a function of the nature of the situation.

Reaction to the Situation as a Whole.- The two theories differ again in respect to the method of perceiving and attacking the situation. The insight theory holds that the subject tends to see the situation as a whole from the start and therefore reacts to it as a unit (see Smith, p. 31). Wheeler gives as a criterion of insight:

> The perception of a goal in its relation to a total stimulus-pattern and self propagation toward it. (43:519)

Ogden also says:

> Learning as here described is not a process of accretion .... It is a pattern and not a content which analysis reveals in the destruction of a previous whole, and in the creation of a new, though subordinate, whole. Likewise a synthesis of two or more wholes is effected pattern-wise and not by mere accretion. (26:251)

On the other hand, Carr, describing trial and error learning says:

> The organism never reacts to the complex situation as a unit. It reacts to the situation in a selective and analytical manner,

i.e., it adapts to first one aspect of the situation and then to another. (6:90)

Thorndike also says:

All learning is analytic. The bond formed never leads from absolutely the entire situation or state of affairs at the moment. Within any bond there are always minor bonds from parts of the situation to parts of the response. (39:32)

And again:

The connections made may then be, not absolutely with the gross situation as a total, but predominately with some element or elements of it .... The action of a situation is more or less separable into the action of the elements that compose it .... that even they (animals) illustrate the general Law of Partial Activity. (39:14)

Does the subject ever perceive and react to a situation as a whole when that situation is absolutely new? Is not such a method of attack a function of the transfer of past experience which has previously associated the parts of a situation thus organizing them into a whole?

Learning of Relationships.- The two theories differ also concerning their interpretation of the perception of and reaction to the relational elements of the learning situation. The advocates of insight consider the learning of relationships between the elements of a situation and the various relations of subject to the situation as a criterion of insight. Wheeler gives this in his list of criteria:

Responding to the constant but abstract features of changing stimulus-pattern; learning the relatively brightest light of a changing combination; "transfer" affects. (43:519-520)

Koffka, interpreting Kohler's work, says:

This Kohler contends that the manipulation of things with reference to their important material relations can be employed as a criterion of behavior with insight - that is to say, of intelligence. (18:217)

Alpert interprets insight, in a like manner (see criterion, p. 38). With respect to this perception of the relationship between subject and goal, Wheeler says:

> The perception of a goal in relationships which have been encountered previously may be taken as a criterion of insight. Since any particular goal, for example food, never presents itself twice in exactly the same configuration of stimuli, any perception of a goal involves new features and can, therefore, be considered a criterion of insight. (43:126)

Those favoring the theory of learning by trial and error feel that their theory quite adequately accounts for the learning of relationships, thus making unnecessary what they feel is the vaguer term insight. They consider that the association of things and events in the contiguity of experience is sufficient to account for the learning of relationships in situations. Repetition of such contiguous experiences was formerly stressed, but more recently Thorndike has developed the Principle of Belongingness as being more potent (see p. 6). Carr, using the term "meaning" in about the same sense that the insight advocates use the term "relations," makes use of past experience in accounting for the learning of such:

> External objects do not intrinsically possess meaning. Rather they are endowed with meaning by the percipient organism, and the amount and character of the significance that they attain is a function of the individual's experience. (6:121)

Again:

> Meaning represents a reflective and analytical mode of utilizing the effects of past experience in effecting a readjustment and the extent to which it is present is a function of the degree of difficulty that is encountered. (6:124)

The question may well be raised: cannot the learning of relationships be adequately accounted for in terms of trial and error

learning plus the transfer of past experience from similar learning situations? And again, if the situation is absolutely new will the subject perceive any relationships in it prerequisite to the learning of such by trial and error activity?

Mental Activity.- The two theories differ also as to their interpretation of the role of mental activity as opposed to overt activity in the learning process. The advocates of insight learning contend that if there is evidence of mental activity preceding the overt adaptive response, that is indicative of insight. Yerkes gives the following as one of the criteria of insight learning.

> Survey, inspection, or persistent examination of problematic situation; hesitation, pause, attitude of concentrated attention. (50: 156)

Wheeler also gives this criterion:

> Periods of initial delay prior to the execution of a new performance, that is, hesitating while studying a novel situation. That is presumably a symptom that the configuration is forming. (43: 520)

Koffka gives this interpretation of the term insight:

> We use this word insight without theoretical presuppositions, in the common sense in which everyone takes it. If one knows that he is about to remove a ring in a certain puzzle, and that in order to do so he must first move this piece and then that, turn the puzzle over and do something else, his procedure will be said to possess a greater degree of insight than the procedure of another who simply goes ahead without any plan at all. (18:179)

Wilmoth uses the term insight in this manner in her study:

> Random or trial and error movements were accompanied by acts of observing and comparing the middle-sized approach with the other two. This period reveals maturation of the learning process, and in this experiment was the basis of what may be called insightful behavior. (45:65)

Many studies of the learning process have made the distinction between human and animal learning in terms of the former being by mental activity while the latter is on the plane of overt movement. (See Ruger, pp. 14-15) As a result many of the studies in animal learning have set as their purpose that of determining whether or not animals can reason. Many of these students have set as the criterion of insight behavior the ability to reason and have classified the various species according to whether or not they possess that ability; that is, as to whether or not they possess the capacity to behave with insight.

The advocates of the trial and error theory hold that their theory adequately accounts for all learning behavior whether that behavior is on the level of overt or mental activity. Carr holds that mental activity is dependent upon preceding overt activity, the former being the more primitive and fundamental (6:101). Carr also considers that overt and mental learning behavior are describable in the same manner:

> The two methods of adjustment are identical in most respects. Both involve a motivating problematic situation, a variable, persistent, and analytical mode of attack which is continued until the solution is more or less accidently discovered, and a series of repeated trials to perfect and fixate the correct responses. In both cases the problem is solved in terms of previous experiences acquired in dealing with similar situations. The motor method involves a series of overt responses to a perceptual situation while reasoning is primarily characterized by the fact that it employs ideas as substitutes for or representatives of those movements or percepts. In the simpler types of reasoning .... the subject utilizes ideas as substitutes for movements instead of performing them. (6:191)

Pechstein also says:

> Random spontaneous activity, either in movements or ideas, is present in all such learning, and the discovery of the adaptive response comes only after a provess of "try, try again," either on the motor or ideational level. (28:76)

But it may well be questioned whether mental activity can be taken as a legitimate criterion of insight learning with the assumption that such phenomena cannot be adequately explained by means of the trial and error theory. Mental learning may be found not to be essentially different in method from overt learning. Furthermore, mental solution may be found to be possible only upon the basis of past experience which has been originally gained by means of overt trial and error learning.

Summary.- In summary, these two theories of learning differ in the following respects: (1) learning is either immediate or else sudden, according to the insight theory, while the trial and error theory holds that all learning in complex situations is gradual; (2) the insight theory has no place for either random activity or chance in the case of immediate learning and holds that insight is fundamental to both chance and random activity in the case of sudden learning; according to the trial and error theory, random activity is the first stage in the learning process in which chance plays an important role; (3) the insight theory describes learning as the perception of and the reaction to the situation as a unit which is greater than the sum of its parts; while the trial and error theory describes all learning as analytic in which the situation is perceived and reacted to by parts; (4) the insight theory considers that the conception of and reaction to relationships in a situation (parts of

the situation to one another, parts to the whole, goal to the subject) can be adequately described only by the term insight; the trial and error theory holds that this phenomenon of learning behavior can be better and more simply explained by the laws of association and the principle of belongingness; (5) the insight theory holds that the mental activity preceding the overt adaptive act is a criterion of insight; the trial and error theory sees both the mental and overt behavior in the learning process as describable in the same manner, and the latter prerequisite and fundamental to the former.

The question has been raised in the case of each criterion of insight as a mode of learning whether such behavior could not be better and more simply explained by trial and error learning with the subsequent transference of experience thus acquired to new situations.

Problems Remaining for Experimental Investigation

Many questions have been raised which make necessary further experimentation before they can be answered. All of these questions involve the validity of the hypothesis which has been advanced by this investigation, namely, that all alleged instances of insight learning are merely instances of the transfer of solutions, previously acquired by trial and error learning, to new situations. More factual evidence is needed in order to answer the following questions:

1. Will learning take place immediately or suddenly when the subject lacks past experience with the essential elements concerned in the problem? Or phrased in another way: are immediate and sudden learning (criteria of insight learning) merely a function of trial and

error learning plus the transfer of past experience?

2. What is the role which chance plays in the learning process? Is insight as a mode of learning prerequisite and fundamental to chance or is insight in such case merely the transfer of past experience?

3. Is there anything in the solution of a problem on the mental level which cannot be adequately described by trial and error learning with the aid of past experience?

4. Does the subject ever react to the relations in a situation or to the situation as a whole except on the basis of associations of those elements which have been previously learned by trial and error and are now transferred to the situation?

CHAPTER III

AN EXPERIMENTAL ANALYSIS OF THE CRITERIA OF INSIGHT LEARNING

Introduction

In order to answer the questions which were raised and to experimentally test the hypothesis which has been advanced certain learning problems were devised and the learning of various subjects observed and interpreted.

The subjects used in these experiments were as follows: (1) a female gorilla, named Susie, approximately six years of age; (2) a male chimpanzee, name Romeo, approximately four and one-half years of age; and (3) eight children of both sexes, ranging from two years and six months to seven years and three months of age. The gorilla and chimpanzee were inhabitants of the Cincinnati Zoological Gardens, and the experiments were conducted with them in their usual quarters. The children used were those of the Cincinnati Parkway Day Nursery, at which place the experiments were conducted. Whenever possible and profitable the learning experiments were duplicated with all subjects; however, this was made impossible at times due to the peculiarities of a certain subject, and at other times was made unnecessary due to previous experiments which had been conducted by others.

No great originality is claimed for the problem situations themselves. The problems were chosen with the view of satisfying the prerequisites for such as laid down by the insight advocates. The problems were all surveyable from one point. There were no hidden mechanisms. It was possible to solve the problems mentally. In some instances there was some past experience with like situations which was definitely a possession of the subject. In other instances there was no such significant past experience with the essential elements of the situation upon which the subject could draw. The study was, to a great extent, an analysis of how the subject used that past experience and the bearing which that use had upon the criteria of insight learning.

The learning problems consisted of the following: (1) the use of a stick as an implement to rake in food placed beyond the subject's reach (subjects: the gorilla and the chimpanzee); (2) the putting of two sticks together to rake in food (subject: the chimpanzee); (3) the opening of a puzzle-box locked by bars to be moved in certain ways (subjects: the gorilla, the chimpanzee, and the children). The learning situations and the apparatus will be described in detail in connection with the report of each learning problem. A description of the experiments and the results obtained follows.

Food and Stick Problem with the Gorilla

Introduction.- This problem has been used with the higher

primates, Yerkes (49, 50) and Kohler (19) being perhaps the first to use this learning situation under strictly experimental conditions. Both of these experimenters have interpreted learning in terms of insight. This present experiment is an attempt to gain new data which will throw light on the alleged criteria of insight learning.

Yerkes (49, 50) has been the only one who has experimentally studied learning in the gorilla. His results were that the gorilla, Congo, could not solve this problem on her own initiative. Thus the results of this experiment may be significant for the general psychology of animal learning as well as the implications which these results may have for the respective theories of learning.

Experimental Situation and Procedure.-

The Subject.- The gorilla, Susie, used in this experiment was a female gorilla estimated to be about six years of age. As far as the published evidence is concerned this is the second time that a gorilla has been the subject for psychological experimentation (the only other instance being that of Yerkes with the gorilla, Congo (49, 50)).*

Place and Time.- This experiment was conducted with Susie at her usual quarters at the Cincinnati Zoological Garden. The experiment was made during the period of January 18-22, 1932, the learning trials being conducted each day, except Sunday, between nine and ten A.M.

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* This being the case, and the behavior of Susie being so different from that of Congo, a more detailed description of her behavior is given in Appendix A, as such is not especially germane to the problem at hand.

The Learning Situation.- The setting of the problem was in Susie's sleeping quarters which furnished excellent conditions. During the day Susie was ordinarily in a glass enclosed cage, in an adjoining room, where she was on display for the benefit of the public. This outer cage was joined to the sleeping room by means of a tunnel through which she could go. A door closed the tunnel at the entrance of the sleeping room. This sleeping room consisted of a room 8' x 12' in which Susie's cage was built. Her cage was approximately nine feet long and five and one-half feet wide at one end and three and one-half feet wide at the other end. The walls of the room served as one side and the wider end of the compartment, while the other side and the narrower end was partitioned off by means of bars.

The problem was each day first set while Susie was out in the outer cage. The door was then opened while she came into the sleeping room, and was immediately closed behind her. After Susie had once come into the sleeping room where the problem was set, it was impossible to make her go back into the tunnel while the problem was being re-set without upsetting her so much emotionally that further experimentation would prove impossible. Therefore, more food was placed on the table with her present in the cage and while she was in possession of the stick.

Food was placed on a table just outside her cage, the food being placed beyond her reach. This table (see Figure 1, p. 62) was fastened to the bars of the cage by means of iron strips and bolts. The dimensions of the table were 26" x 30". The food was placed in

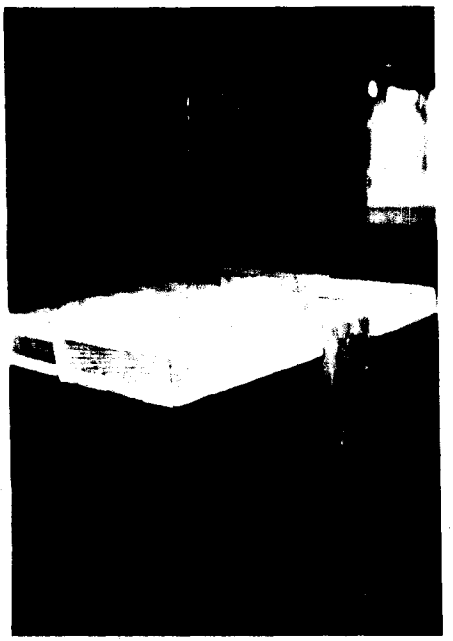


Fig. 1.- Table and General Setting for the Food and Stick Problem with the Gorilla.

the center of the table about six inches from the side farthest from the subject. The bars of the cage were just wide enough to allow Susie to get her hand through up to her wrist. A stick, the dimensions of which were 1" x 2" x 24", was placed on the table, extending halfway into the cage.

The experimenter and the keeper were always in the room during the experiment (but not in the cage itself).

The number of trials run in a day depended upon how well Susie continued to be motivated by the problem situation, but in general the entire time of experimentation for a day did not run over forty-five minutes consecutively.

Records.- A time record was kept of each trial, the time consisting of the interval from the instant Susie entered the room, or the time food was placed on the table in her presence, to the time Susie obtained the food. A descriptive record was also kept of her learning behavior.

Criterion of Learning.- The criterion of learning consisted of four successive solutions with no errors. An error was any random movement which revealed that the subject did not know how to use the stick to get the food, e.g., reaching for the food with the hand, pushing the food in the wrong direction, etc. This criterion of learning, though an arbitrary one, is obviously a harder one than the insight psychologists have been accustomed to set. They have been content when the subject solved the problem once. The present experimenter feels that one solution cannot be taken as a criterion

of learning, but that repeated solution without error is necessary.

The Learning Data.-

Trial 1. (January 18) Susie notices the table immediately and coming to it takes the stick in one hand and reaches with the other hand trying to get the food. Being unable to reach the food she ceases her efforts immediately and sits down on the floor and begins playing with the stick. She returns to the table (three minutes) reaches first for the food with her hand, and then thrusts the stick through the bars and waves it first in the air above the food and then back and forth on the table, knocking the food from side to side. Her attention is not directed toward the food itself. Quite accidently the food is knocked within reach. Susie does not see the food knocked closer to her and is still sliding the stick back and forth on the table. Presently she looks down at the table and sees the food close to the bars and reaches it. Time: 3 minutes, 45 seconds.

Trial 2. (January 18) Susie gets the stick from the table and without trying to reach the food begins playing with the stick. She returns to the table (two minutes) and putting the stick through the bars waves it back and forth, the farther end resting on the table. The food is knocked from one side of the table to the other, but no closer to her. She then takes the stick back into the cage and races about with it, then sits down and begins playing with it. She returns to the table (about six minutes) and thrusting the stick through the bars waves it back and forth across the table without striking the food. She now sits down and begins playing with the stick again. As the food is not in a very advantageous position the experimenter moves it. Susie immediately rushes to the table and putting the stick through the bars knocks the food from side to side. Her attention is directed to the food during these actions, but her movements are unsuccessful. She soon returns to her play with the stick. At about the end of fourteen minutes she returns to the table and pushing the stick through the bars so that it rests on the table, she pushes it back and forth with her hand, at times thrusting it out and pulling it back. In the course of such actions the farther end of the stick happens to get behind the food, the stick itself being at about a forty-five degree angle to her. The stick is pulled in and the food comes with it, falling into the cage. She sees the food and immediately picks it up. Time: 15 minutes, 30 seconds.

Trial 3. (January 19) Susie immediately tries to put the stick through the bars, but in so trying she holds the stick horizontally to the vertical bars. Being unable to get the stick through the bars this way she drops it and beats upon her chest angrily. She then sits down and begins playing with the stick. Five minutes pass with no attention given to the food. The experimenter then places some additional food on the table and Susie immediately rushes to the table. She pushes the stick through the bars so that

it rests on the table. She then pushes the stick back and forth with her hand. The stick is pushed about in a random manner, knocking the food from side to side. In the course of such behavior the food is knocked within reaching distance. Susie's attention was directed toward the food, and seeing it knocked closer to the bars she reaches and getsit. Time: 7 minutes, 34 seconds.

Trial 4. (January 19) Susie immediately pushes the stick through the bars toward the food, then pushes the stick from one side of the table to the other. The food is pushed to the left side of the table. Susie soon ceases this behavior and taking the stick within the cage begins playing with it. She returns to the table (about four minutes) and first pushes the stick toward the food, then picks up some straw in her cage and pushes it toward the food. The stick accidentally falls from the table, falling between the screen wire and the bars and floor of her cage. (See Figure 1, p. 62) In trying to recover the stick she pulls it horizontally toward her in such way that the screen wire is being pryed off. With great difficulty is she stopped from this destructive behavior, but as soon as the stick is gotten out for her she tries to re-place it that she may continue her destruction, but is unable to do so. It is some time before interest in this wanes and she returns to the table (about thirteen minutes). She pushes the stick out on the table and pushes it back and forth. In the course of such behavior the farther end of the stick gets behind the food, the stick itself being at about a forty-five degree angle toward her. Susie immediately pulls the stick in and the food with it. Her attention was directed toward the food and she reaches, getting it. Time: 14 minutes, 20 seconds.

Trial 5. (January 19) Susie comes immediately to the table and pushes the stick out on it in such a way that the farther end of the stick is behind the food, the stick itself being at about a forty-five degree angle to her. She pulls the stick in and the food comes with it. Time: 45 seconds.

Trial 6. (January 20) She comes to the table and reaches for the food. She then sits down and begins playing with the stick. During the course of her play she notices the wire screen which she tried to tear off the day before and tries to insert the stick as before but fails. It is about five minutes before she returns to the table and pushes the stick toward the food. She waves the stick back and forth, the farther end resting on the table. Now she drops the stick on the table and pushes it about with her hand. She pushes the stick toward the food and then pulls it back toward her. This is done regardless of the position of the stick to the food; that is, regardless of whether the stick is in front or behind the food. In the course of this activity the stick gets behind the food. Immediately Susie pulls it in and the food comes with it. Time: 6 minutes, 45 seconds.

Trial 7. (January 20) At the beginning of this trial the experimenter was in possession of the stick. Before the stick could be given Susie she picked up a straw and tried to use it to get the food. The stick is given her and she immediately drops the straw and waves the stick about in the direction of the food. She then takes the stick into the cage and plays with it. At about two and one-half minutes she returns to the table and pushes the stick out on it in such a way that the farther end is behind the food. She immediately pulls the stick in and the food with it. Time: 2 minutes and 50 seconds.

Trial 8. (January 21) Immediately Susie pushes the stick on the table and secures the food in the same way that she had gotten it in trial 7. Time: 30 seconds.

Trial 9. (January 21) Food secured immediately in the same manner as in the two previous trials. Time: 10 seconds.

Trial 10. (January 21) Susie pushes the stick out on the table and pulls it toward her as before, but the stick did not happen to get behind the food. She then takes the stick into the cage and begins playing with it. She notices the torn screen wire and tries to again insert the stick there. Being unable to do this her interest in it soon wanes and she returns to the table. The stick is first held in the hand and waved back and forth, the farther end resting on the table. The stick is then dropped on the table and pushed with the hand toward the food, then pulled toward her. The stick does not get behind the food so the food was not raked in. Immediately Susie pushes the stick out again. This time the farther end gets behind the food and the food is raked in as she pulls the stick toward her. Time: 2 minutes, 10 seconds.

Trial 11. (January 22) Susie immediately pushes the stick out on the table so that it lies with the farther end behind the food. She then quickly pulls it in. Her attention is directed toward the food and her actions all seem to be purposive. Time: 8 seconds.

Trial 12. (January 22) The food is secured immediately in the same manner as in trial 11. Time: 12 seconds.

Trial 13. (January 22) Same, no errors. Time: 15 seconds.

Trial 14. (January 22) Same. Time: 15 seconds.

Trial 15. (January 22) Same. Time: 25 seconds.

Trial 16. (January 22) Same. Time: 20 seconds.

Interpretation.- Susie's learning curve for this problem is presented in Figure 2, page 68. The curve is in terms of time taken per trial as errors in this learning process would be extremely difficult to enumerate. Despite the rather erratic character of this learning curve there is a gradual diminution in time required for solution. The wide difference in time required on trial 1 and trial 2 is to be explained by the fact that success in both instances was largely a matter of chance, and Susie did not observe the chance happening in the former trial. Trial 2 shows that all she might have learned in the first trial was that the stick was in her hand and being waved in the direction of the food when the food was secured. But simply waving the stick at the food in trial 2 did not achieve solution since the stick did not happen to strike the food in the same way. The sudden rises in the curve on trials 4, 6, and 10, are due to the diverted interest in trying to tear up the cage.

The experimenter felt that Susie had reached the maximum of her ability to master the situation when the time required for solution stayed consistently under thirty seconds for six trials distributed over two successive days, and especially since there were no errors in these trials.

A very casual inspection of the learning data reveals the decided trial and error tendencies in the learning process. Only very gradually did the concept of an effective use of the stick develop. The first impulse was to reach for the food with the hand. When this reaction proved futile, the next impulse was to play with

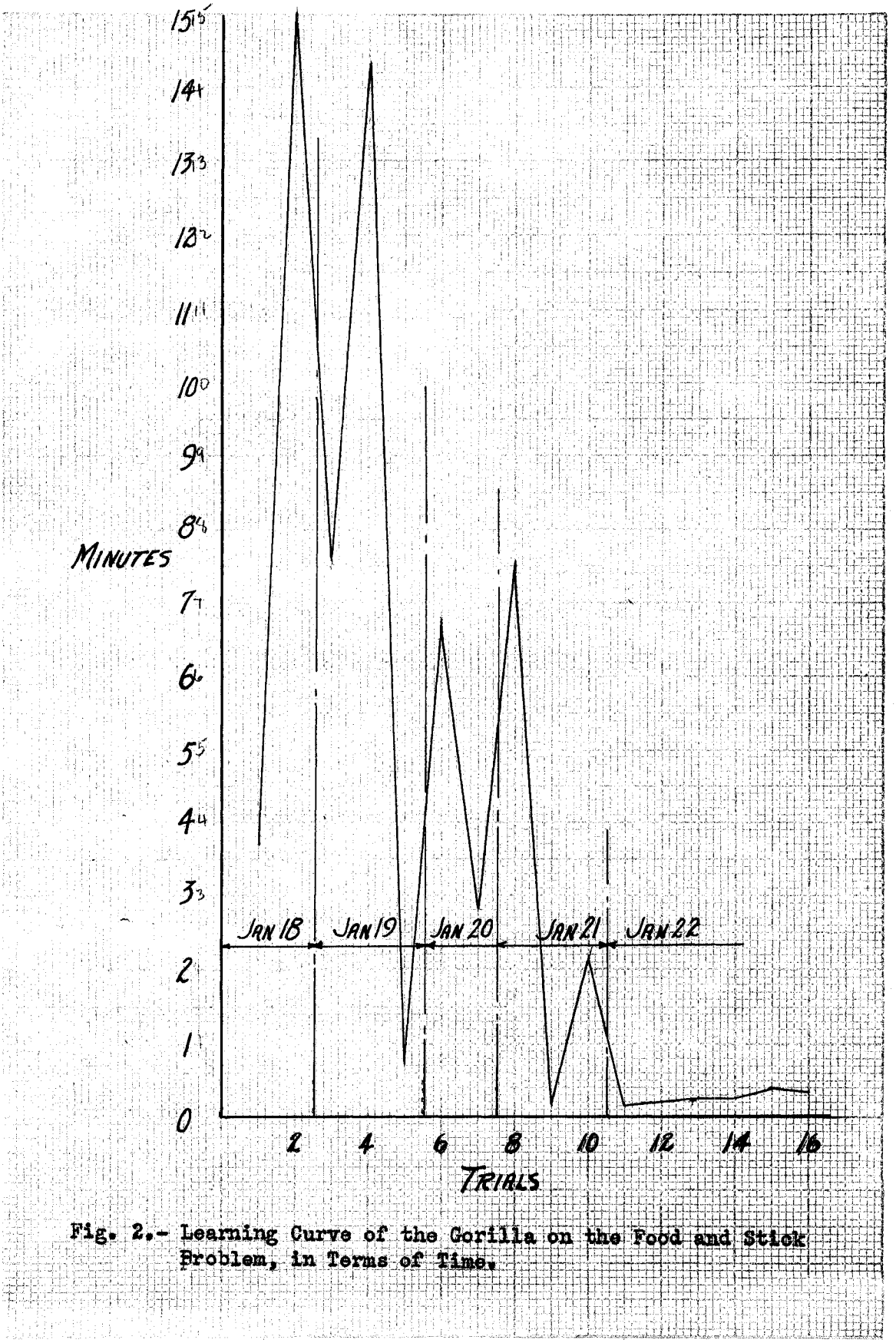


Fig. 2.- Learning Curve of the Gorilla on the Food and Stick Problem, in Terms of Time.

the stick, the stick itself becoming a goal. When the stick was finally used it was merely something to wave around in the air and on the table in the direction of the food. Quite accidently did the food and stick come into contact in such a way that the food was knocked within reach. Susie was not looking at the food during this activity and there can be little doubt but that the solution was accidental. Little learning could have taken place as a result of this chance behavior since Susie did not observe directly the consequences of her actions.

In trial 2 Susie learned a more effective use of the stick. She learned that the stick could better be manipulated through the bars by laying the stick on the table and then pushing it about with the hand. But her movements in that trial were not in any way purposive; she did not first see what to do and then do it. She was simply engaging in trial and error activity, in the course of which the stick happened to come into contact with the food in such a way as to achieve solution. But during this second trial Susie was watching the food and so saw the consequences of her random act.

From trials 2 to 7 Susie seems to have gradually learned the advantage of "stick behind food" so that when that relationship was achieved by chance in the course of random manipulation, she immediately recognized it and pulled in the stick and the food with it. The insight psychologists would undoubtedly claim that the ability to recognize this advantageous situation brought about by chance was indicative of insight; that is, that insight was prerequisite to chance (see p. 48). But how was the ability to perceive

and react to this advantageous chance situation acquired? The first time Susie secured the food she did not learn from that experience any definite use of the stick due to the fact that she did not observe her own movements and their consequences. The second time she obtained the food it was by chance that the stick, in the course of random activity, was placed behind the food so that it was raked in. But Susie was observing her own movements and their consequences this time. Thus Susie learned from this experience a relationship between the stick in a certain position to the food and the stick pulled in a certain way, that is, an association was formed. Gradually, in subsequent trials, whenever this relational position was achieved in the course of trial and error activity, it was recognized and properly responded to. We may now say that Susie has insight into the problem; that is, perceives relationships, but this insight as a fact of experience was merely a product of trial and error activity. It follows that insight cannot be thought of as a mode of learning. It can, at most, be thought of as the end result or the fact of learning. Learning, as such, takes place by means of trial and error.

Susie had further to learn how to achieve that relation of stick behind food, so that the stick would be placed there purposively. That learning took place very gradually, maturing in the eleventh trial. (The immediate success in trial 5 seems, in the light of the subsequent trials, to have been a matter of chance.)

There is no evidence to show that Susie ever first decided what to do and then did it. The problem was solved on the level of

overt movement.

The question may be raised as to why Susie ever used the stick in respect to the food. Even here past experience seems sufficient as explanation. In trial 4 Susie endeavored to use straw as she had used the stick. Again in trial 7 before Susie was given the stick she picked up a straw in her cage and tried to use it as a substitute for the stick. But it may have been that all along Susie was simply using the stick as a substitute for straw; and experience proved it to be a better implement. The straw had been a part of her environment for years and she had had ample opportunity to learn its many uses in the course of random behavior. Subsequent experiments revealed that Susie often used straw as an implement, though it was a very poor one. But unless we are willing to assume that Susie was born with an instinct or an innate idea to use straw as an implement to secure things out of her reach, we must conclude that such was learned in the course of trial and error activity.

Summary.-

1. The gorilla learned to secure, by means of a stick, food placed on a table outside her cage and beyond her reach. This learning was achieved on her own initiative.

2. The learning was on the level of overt trial and error movement. There was no evidence that she first saw what to do and then did it.

3. Chance, in the course of random manipulation, played an important role in learning. Chance solutions preceded recognition

of the consequences of the essential acts.

4. The ability to recognize and to respond to relations brought about by chance can be adequately explained on the basis of the transfer of past experience, which past experience was originally learned by trial and error; hence we do not need the concept of insight as a mode of learning for such explanation.

5. The subject did not perceive or react to the relationships in the situation until such relationships were learned, and learned gradually, by contiguous experience gained in the course of trial and error activity. Subsequent use of such acquired experience constitutes merely the transfer of past experience. We cannot speak of insight as a method of learning, but only as a word to describe the end result or fact of learning.

6. There is evidence that Susie transferred to this problem some learning which she had acquired in her experience with straw, which transfer served as the basis for her first responses with the stick in relation to the food.

Food and Stick Problem with the Chimpanzee

Experimental Situation and Procedure.-

Subject.- The chimpanzee, Romeo, used in this experiment was a male chimpanzee about four and one-half years of age. If one may venture a guess this subject may be said to possess a better disposition (as far as adaptation to the experimental situation is concerned) and a higher intelligence than the average of his species (this comparison being based upon the general published

description of chimpanzee behavior). (51:336-337)

Place and Time.- The experiment was conducted in the subject's usual quarters in the Cincinnati Zoological Garden. The time of the experiment was between ten and eleven A.M. on January 22, 1932.

The Learning Situation.- As nearly as possible the learning situation was made like that of the former experiment with the gorilla. The cage in which the chimpanzee was kept is approximately 10' x 20'. At one end of the cage is a door leading into an ante-cage which is approximately 4' x 4'. The floor of this ante-cage served as a substitute for the table. The bars of the cage were wide enough to allow the chimpanzee to reach through the entire length of his arm. Food was placed beyond his reach and a stick 1" x 2" x 26" was placed on the floor, extending halfway into the cage. (See Figure 3, p. 74.)

While the problem was being originally set the chimpanzee was kept in a smaller cage which was within the larger cage and which was located at the opposite end. (This smaller cage was his sleeping compartment.) While the problem situation was being reset the keeper attracted the chimpanzee's attention to the other end of the cage. Only the experimenter and the keeper were present during the experiment, both being outside the cage.

All the trials for the learning of this problem situation were on the same day.

Records.- A time record was kept of each trial, the time

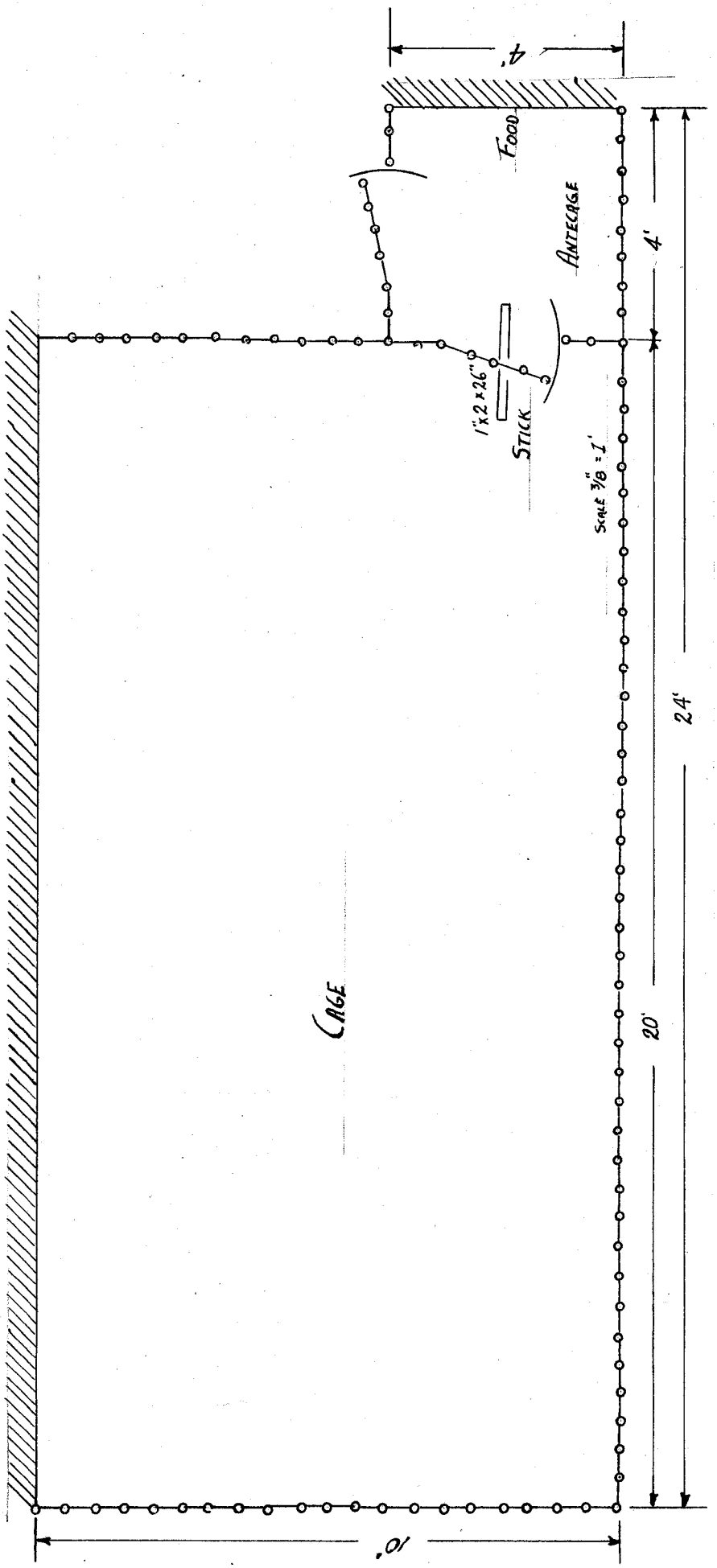


Fig. 3.- Cage and General Setting of the Food and Stick Problem for the Chimpanzee.

interval consisting of the time from the instant the subject came to the stick and the food to the time the food was secured. A descriptive account was kept of the subject's learning behavior.

Criterion of Learning.- The criterion of learning consisted of four successive successes without error. An error consisted of a random movement which revealed that the subject did not know definitely how to solve the problem (such as reaching for the food with the hand).

The Learning Data.-

Trial 1. (January 22) Romeo takes the stick from where it is between the bars of the ante-cage and sits down and begins playing with it. He apparently saw the food but made no effort to try to get it. Seven minutes pass, during which time he plays about the cage with the stick. The stick is broken and the experimenter gives Romeo another. He begins his inspection of the new stick and then proceeds to play with it as with the other. At about eight minutes he comes to the bars of the ante-cage and reaches for the food. He has left the stick on the floor behind him. Being unable to get the food he returns to his play with the stick. At about nine minutes he returns to the food. This time he has the stick with him. He sits down on the floor and then very slowly, but definitely, he takes the stick in his left hand and rakes in the food. During this last behavior with respect to the food there was not one random overt movement. Time: 9 minutes, 10 seconds.

Trial 2. Romeo takes the stick into the cage and begins playing with it. At about the end of a minute of such play he comes to the bars of the ante-cage, with stick in hand. He sits down on the floor and taking the stick in his left hand begins raking in the food. The food is pushed too far to the right and he immediately shifts the stick to the right hand and finishes raking in the food. Time: 1 minute, 20 seconds.

Trial 3. The food is secured immediately. The stick is held in the left hand. There are no random movements. Time: 10 seconds.

Trial 4. Same. Time: 15 seconds.

Trial 5. Same. Time: 12 seconds.

Trial 6. Same. Time: 10 seconds.

Trial 7. Same. Time: 10 seconds.

Trial 8. Same. Time: 14 seconds.

Interpretation.- The data for the learning in the case of the chimpanzee with the stick seems on the surface to indicate an entirely different kind of learning. Here there is none of such overt trial and error movements as appeared in the case of the gorilla. The curve of learning, in terms of time, (see Figure 4, p. 77) makes a sudden drop between trials 1 and 2 and then stays consistently low. The long time taken on trial 1 is to be explained largely by the fact that during that trial the play motive was more potent than the hunger motive. The stick as a new plaything was an end in itself rather than a means to another end. The solution may be spoken of as immediate, rather than sudden, since the chimpanzee did not make any random movements while attending to the food with the stick. In fact, the solution came so suddenly and easily that one doubts whether it was ever a real problem.

The play motive predominated again for the first minute in trial 2. In the following trials this motive waned and the hunger motive became more potent. The stick then ceased to be a thing with which to play and become a means to another end.

The ease with which the chimpanzee solved the problem may well raise the question as to whether it was in reality a problem for him. Wilmoth (see p. 46) concludes from her study that if there is immediate solution there is no problem for the subject, hence no

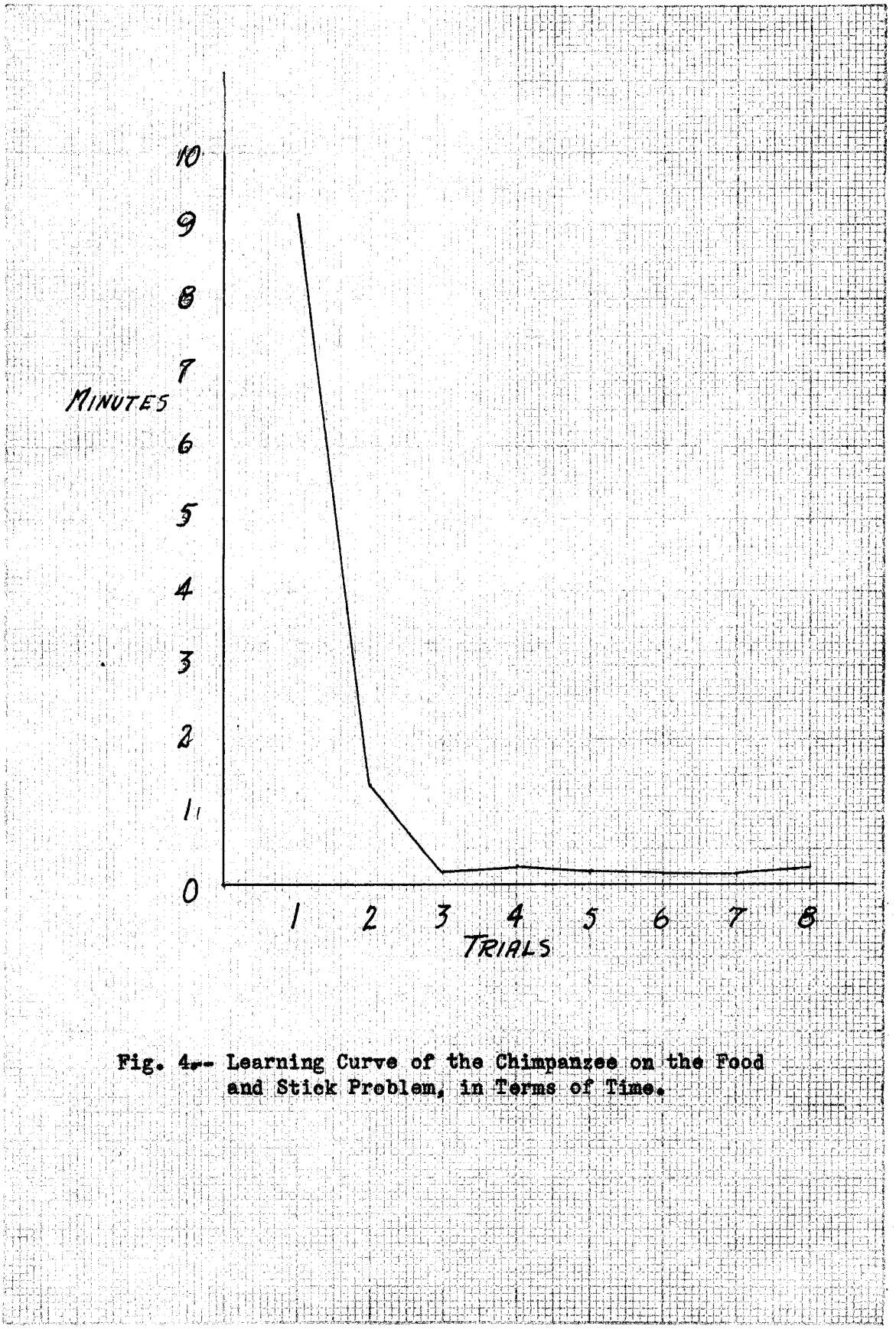


Fig. 4.-- Learning Curve of the Chimpanzee on the Food and Stick Problem, in Terms of Time.

learning takes place. But unless the chimpanzee had at some time back in the past actually used a stick to rake in food, then for him there was something new in this situation, and that "something new" he had to learn. (That is, unless we assume that the problem was solved by instinctive behavior or by innate ideas.) The question, then, is this: what experience had the subject had with this situation, or elements of it? The keeper says that Romeo had had possession of a stick only once before this experiment and then for about twenty minutes time, during which time he merely played with it. There was no food present with which the stick could have been used. It may be concluded, then, that the subject had never solved this exact problem before, and that when he did solve it, learning, to some degree, must have taken place. But in the light of the ease with which he did solve the problem it may be assumed that very little new learning took place. This raises the question: what experience with similar situations had the subject had? He may not have used a stick as a means of raking in things out of his reach but he may have previously learned to use things like a stick for such purpose. What things or thing similar to a stick had he had experience with? In his cage there is always an abundance of rice straw. This straw is very long and heavy. In the course of subsequent modifications of this experiment the chimpanzee often used straw as a substitute for the stick when the stick did not prove to be efficient. Also the chimpanzee has often been observed to use straw with which to scrape the glass which encloses his cage, the glass itself being beyond his reach. May it not be that when the chimpanzee was using the stick

he was merely using it as a substitute for the straw? (The use of the straw itself has presumably been learned originally in the course of random behavior.)

This problem was made simpler for the chimpanzee because he had past experience with similar situations which he transferred to the situation. This transfer of past experience limited the need for overt trial and error activity. But since the stick was not exactly like straw and the food was not exactly the same as the things which he had pushed about with straw, there were new elements in the situation. These new elements had to be learned. Therefore, the first reaction, though it was in terms of past experience, was no less a trial even though it was correct, and the learning was no less trial and error in method. Immediate solution, then, is not indicative of insight, but a function of the amount of relevant past experience which the subject has to transfer to the situation.

Summary.-

1. The chimpanzee solved the problem of using a stick as an implement to secure food placed beyond his reach outside the cage.

2. The problem was solved suddenly. There were no random movements, no errors, with respect to the goal.

3. There is no reason to assume insight as an explanation of this sudden solution. The transfer of past experience with like situations is sufficient to account for this suddenness of learning.

4. There is no reason to suppose that no problem existed for the chimpanzee. There were some new elements in the situation, hence they constituted a problem. But the past experience possessed

by the chimpanzee, which past experience had been acquired by trial and error activity, limited the need for trial and error activity in this situation. Since there was something new (here was a stick instead of straw, and here was food instead of a "thing-a-bob") the first overt "try" was no less a trial and the behavior no less trial and error, or better, trial and success.

Food and Jointed-Stick Problem with the Chimpanzee

Introduction.- This problem situation has been used by Kohler in experimenting in chimpanzee learning and the learning has been interpreted by him in terms of insight. The question has been raised as to whether or not this learning could not better be accounted for in terms of trial and error plus the transference of past experience. This problem is especially well adapted to the subject at hand and the purpose of this study. The subject solved the single stick problem practically immediately. We have interpreted this immediate solution in terms of the past experience which the subject brought to the situation. If this interpretation is correct, then a more complicated problem ought to reveal overt trial and error movements. (By "more complicated" we mean a problem with which the subject has less relevant past experience.) The jointed stick problem would be more complicated. There is only one new element in it for the subject to learn, that is, to join the two sticks together purposively to get the food. But it may well be assumed that the subject has had no past experience with this element. When a problem contains a distinctly new element how will learning take place? In such case are the criteria of insight learning over satisfied? This

problem should answer these questions.

Experimental Situation and Procedure.-

Place and Time.- This experiment was conducted during the period of January 26-29, 1932. The learning trials were held approximately between ten and eleven A.M. each day.

The Learning Situation.- This learning situation was identical with the one in the preceding problem, with the following exception: two sticks, instead of one, were provided. These sticks were hollow bamboo, both being twelve inches long. One stick was smaller than the other so that it might be fitted easily into the end of the larger one. Either stick, used separately, was too short to be effective in raking in the food. The only way in which the problem could be solved was to join the two sticks together and use this constructed implement to rake in the food. The two sticks were placed beside each other, extending halfway into the ante-cage. (See Figure 5, p. 74, for the general setting of the problem.)

Records.- A time record was kept of each trial, the time consisting of the interval between the instant the subject reached the bars where the food and sticks lay, and the instant the food was obtained. A descriptive account of the learning behavior was also recorded.

Criterion of Learning.- The criterion of learning consisted in four successive solutions without error. An error was any attempt to get the food without the use of the jointed stick (as, reaching for the food with the hands, trying to get the food by the use of one of the sticks, etc.).

The Learning Data.-

Trial 1. (January 26) Romeo makes no attempt to get the food, though apparently he sees it. He picks up the two sticks and begins playing with them. At about three minutes he notices the hole in the end of the larger stick and inserts his thumb into it. After doing this several times he picks up the smaller stick and tries to insert it, but fails. He then picks up some straw and succeeds in getting some of it into the hole in the larger stick. He immediately pulls the straw out, however. He now resumes his random play behavior with the sticks. At about five and again at six minutes he tries to insert the smaller stick into the hole in the larger one, but fails. He comes to the ante-cage at about nine minutes and tries to rake in the food with first the larger stick and then the smaller one. Not succeeding, he resumes his random play behavior. Several times he tries to poke the smaller stick into the larger one, but fails due to the fact that his movements are not well enough coordinated. This play continues until thirty minutes have passed and Romeo seems to have given up getting the food. The experiment is discontinued and failure recorded.

Trial 2. (January 27) Romeo reaches for the food with the hand, then tries to rake it in with the larger stick. He then begins playing with the two sticks. Presently he notices the hole in the larger stick and pokes his thumb into it. Pulling his thumb out he immediately picks up the smaller stick and succeeds in inserting it into the hole in the larger one. He plays with this jointed stick for about one-half minute, then in the course of his play pulls the jointed sticks apart. He plays with the two sticks for some time. At the end of about twelve minutes Romeo comes to the ante-cage and tries to rake in the food with the larger stick. Not succeeding in this he plays about the cage with the two sticks. At about fifteen minutes he puts the two sticks together again, but after playing with them for some time, pulls them apart. After playing about a minute after this he comes to the food and tries to rake it in with the smaller stick, the larger one being left on the floor behind him. He then returns to the larger stick and resumes his random play. After playing a while he succeeds in joining the two sticks together. He plays with this jointed stick for a little while, then comes to the ante-cage with it and using it succeeds in raking in the food. Time: 17 minutes, 20 seconds.

Trial 3. (January 28) Romeo inserts the smaller stick into the larger one almost immediately and plays with the jointed stick until it falls apart. He continues his play with the sticks until at the end of two and one-half minutes he comes to the ante-cage and tries to get the food with first the smaller, then the larger stick. Failing in this, re resumes his play. During this course of this play he puts the two sticks together several times but always pulls them apart either immediately or in the course of subsequent play. At

about ten minutes he tries to get the food with the larger stick. He returns to his play. For about five more minutes he plays about the cage, all the while with the sticks. Again he puts the sticks together and after playing a while, brings the jointed stick to the bars of the ante-cage and using it secures the food. But, as in trial 2, there is no evidence that Romeo ever put the two sticks together purposively to get the food. They just happened to be together when he made this last attempt to get it. Time: 16 minutes.

Trial 4. (January 28) Romeo picks up the larger stick and tries to get the food with it. Then he picks up the other stick also and plays with the two. At the end of about a minute he inserts the smaller stick into the larger one. Almost immediately he comes to the ante-cage and using the jointed stick rakes in the food. There is no evidence that Romeo put the two sticks together in order to use the jointed stick to get the food. However, there is some evidence to show that he did recognize the advantage of the jointed-stick when it was achieved. Time: 1 minute, 18 seconds.

Trial 5. (January 28) He first tries to get the food with the larger stick. Failing in this, he takes both sticks into the cage and plays with them. At the end of about a minute and one-half he inserts his thumb in the larger stick, then puts the smaller stick into it. Immediately, he rushes to the ante-cage and rakes in the food. Time: 1 minute, 50 seconds.

Trial 6. (January 29) Using the smaller stick he tries to get the food. Then he takes the sticks into the cage and plays with them. At the end of about two minutes he inserts the smaller stick into the larger one. He plays with the jointed stick for about one-half a minute, then he looks at the food in the ante-cage and rushing across to it, uses the jointed stick to rake in the food. Time: 2 minutes, 45 seconds.

Trial 7. (January 29) Romeo picks up the two sticks and sitting down on the floor in front of the ante-cage he immediately puts the two sticks together and gets the food. Time: 40 seconds.

Trial 8. (January 29) Same. Time: 48 seconds.

Trial 9. (January 29) Same. Time: 37 seconds.

Trial 10. (January 29) He puts the two sticks together immediately but in using the jointed stick to get the food, it falls apart. The smaller stick has fallen on the floor in the ante-cage out of his reach. Immediately Romeo uses the larger stick which he holds in his hand to rake in the smaller one, puts the two sticks together again and gets the food. Time: 1 minute, 15 seconds.

Trial 11. (January 29) The sticks are put together immediately and the food gotten. Time: 39 seconds.

Interpretation.- The sudden descent in the learning curve for the chimpanzee in this problem situation might seem, on the surface, to indicate insight learning. (See Figure 5, p. 85) The curve descends suddenly between trials 2 and 3, and then stays relatively low until learning is complete. But a more thorough analysis of the learning data reveals that the problem was solved by trial and error. Instead of sudden, or almost immediate, solution, as in the case of the single stick problem, the first trial lasted for thirty minutes and ended in failure. During this trial there was nothing but random play activity with the sticks and response in terms of past experience with the sticks in relation to the food. In trial 2 on the next day the chimpanzee seemed to have almost given up getting the food as he played for about twelve minutes before he made an attempt to secure it. His reactions were in terms of past experience. He came to the bars time and time again and tried to get the food with either one of the sticks used separately. When experience should have proved this response futile it was still continued. This behavior corresponds to that of the humans in Ruger's puzzle problems (see pp. 14-15).

We can only conclude that the subject reacts in this learning situation in terms of trial and error (as far as the essential element of the learning situation is concerned) because of a lack of past experience which will make possible immediate solution without overt trial and error movement. The subject's past experience being insufficient to achieve immediate solution, that experience had

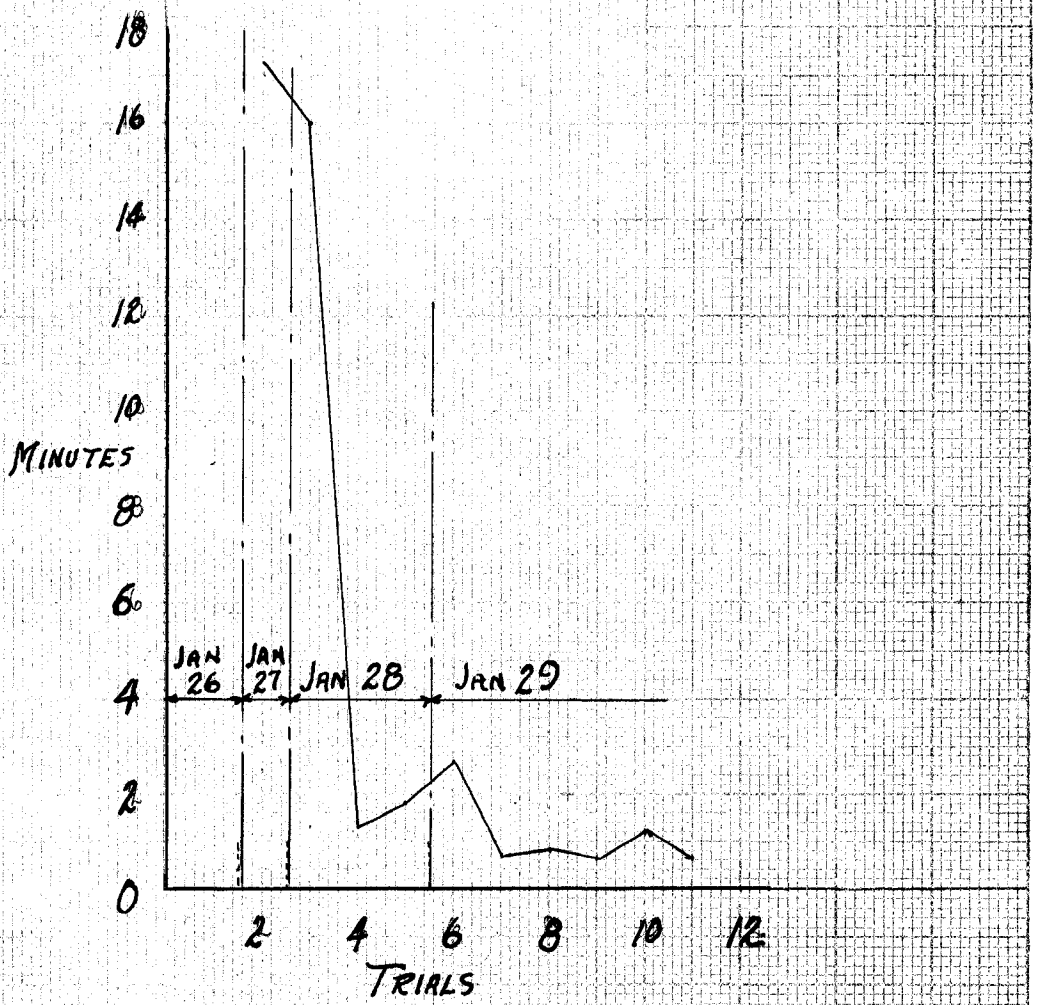


Fig. 5.- Learning Curve of the Chimpanzee on the Jointed-Stick Problem, in Terms of Time.

to be gained in the course of trial and error activity in the problem situation itself.

Chance played a dominant role in learning. The hollow stick attracted the chimpanzee's attention. A hole meant something to be investigated - it meant the poking of something into it. The first thing used was his thumb, then the smaller stick. Straw was then poked into the hollow stick. It may well be assumed that in his behavior with the sticks he was transferring much past experience learned with the straw. Finally he succeeded in getting the smaller stick inserted into the larger, but when he had accomplished this his purpose seems to have been fulfilled. This activity was an end in itself, not a means to an end. He either played with the jointed stick until it fell apart or else he pulled it apart. During the course of this play he occasionally came to the ante-cage and tried to rake in the food. It was merely by chance that upon one occasion the two sticks were joined when he attempted this. They had not been joined for that purpose. But that chance happening in the course of random behavior achieved solution. But it took several repetitions of this chance solution to affect learning; that is, to achieve recognition of the relation between the two sticks joined and success in getting the food. In trial 4 that recognition came suddenly, but if recognition, as such, ever came, it had of necessity to come at one time, hence suddenly.

But there is a difference between recognizing the advantage of a relation which has been achieved by chance, so that it is responded to, and the purposive achieving of that relation itself.

It took several more trials for the chimpanzee to learn purposively to effect that relation.

There is no reason to use the term insight with its respective criteria to describe this learning. Insight is not needed as prerequisite and fundamental to chance. Past experience alone is sufficient to explain learning behavior in the former part of the learning process. The subject reacted in terms of his past experience until a chance response achieved solution. Trial and error activity with its attending chance, plus the transference of past experience, completely describes the learning behavior.

Sudden solution of itself could not be taken as a legitimate criterion of insight learning in this problem, since the solution could come in no other way. On the other hand, learning took place gradually, the sudden maturing of learning being a function of the nature of the problem itself. It is well worth noting that the chimpanzee first solved this problem without knowing just how he did it; in fact, that realization came to him very gradually in repeated solutions.

Summary.-

1. The chimpanzee solved the problem of joining two sticks together to make a larger stick which was effectively used to secure food outside the cage.

2. The problem was solved on the level of overt trial and error movement. There is no evidence that the chimpanzee first saw what to do and then did it.

3. The solution of this problem by means of overt trial

and error is to be explained by the fact that the problem was more complicated for the subject than was the single stick problem. By "more complicated" we mean merely that the subject had less past experience to transfer to the situation. Thus overt trial and error is seen to be a function of the newness of the problem. It follows, then, that the solution of a problem immediately and without trial and error activity is a function of the transfer of past experience and as such is not a valid criteria of insight learning.

4. Chance played a dominating role in the solution of the problem. In the course of random play activity the chimpanzee chanced to do certain things which led to the solution of the problem. Response to the goal was in terms of past experience until a chance successful act resulted in solution.

5. There is no need to assume that there is insight prerequisite and fundamental to chance which makes the latter effective. It took several repetitions of the chance solution to effect recognition of the consequences of the chance act; that is, it took several repetitions of the experience of the contiguous elements of the situation before recognition of the essential relations of the problem was effected.

6. Sudden solution cannot be taken in this problem situation as a criterion of insight since solution took place without true learning. Learning itself came very gradually, the sudden maturing of the learning being a function of the nature of the situation. The word insight can be used only as synonymous with the word learning; that is, to describe the fact of learning.

Puzzle-Box Problems with the Gorilla

Introduction.- Puzzle boxes (sometimes called problem-boxes) have frequently been used to study the learning process in both animals and humans. The puzzle-box furnishes the opportunity to devise problems ranging from the relatively simple to the very complex. Some experiments using the puzzle-box have been criticized vigorously because they have contained hidden mechanisms which had of necessity to be learned accidentally or that the manipulation of the mechanism was itself not fitted to the subjects used. The present puzzle-box situations have been devised with these criticisms in mind. There are no hidden mechanisms. The entire problem situation is surveyable from one point. It would be possible to solve the problem mentally. The subject used has the natural means (that is, hands) with which to manipulate the mechanism. It may well be assumed that the subject had no past experience with the essential elements in the first problem situation. Thus learning had to take place in the problem situation itself and could be observed.

The present puzzle-box problems are a modification of those used by various previous experimenters. The learning situations themselves are not so new, but the purpose of the experiments is distinctly new.

Experimental Situation and Procedure.-

The Puzzle-Box.- The puzzle-box (see Figures 6 and 7 for a photograph of this) was a box 15" x 15" x 15", made of one inch board. Figure 8 gives a detailed picture of this box. The lid (see

X, Figure 8, p. 92) was locked by means of iron bars one and one-fourth inches wide and three-eights inch thick. These bars were fastened in most instances to the lid and the lid was locked by sliding them under catches fastened to the box. (See Figure 9, p. 92) The box was held in place by nailing it to the floor and by means of an iron band which bolted to the bars of the cage. All this stability of construction was made necessary because of Susie's extreme strength and tendency toward destruction.

In problem (a) there was only one bar locking the box, this bar being in the center of the lid (see "a", Figure 8, p. 92). The lid could be unlocked by moving the bar to the right. In problem (b) there was another bar added to the left side of the lid. This bar was otherwise identical with "a" (see "b", Figure 8, p. 92). In problem (c) there was a third bar added to the left side of the lid (see "c", Figure 8, p. 92). This bar was identical with the others with the exception that it could be moved clear of its catch only by moving it to the left. In problem (d) the lid was locked by means of three inter-locking bars (see Figure 10, p. 93). These bars had to be moved in a serial order of "a", "b", "c", as "a" blocked the course of "b" until the former was cleared of its catch, and likewise "b" blocked the course of "c" until "b" was first moved.

Procedure.- The problems were presented in the order of (a), (b), (c), (d). But Susie was unable to solve problem (d), therefore problem (e) was presented. This problem consisted of two inter-locking bars ("b" and "c", see Figure 10, p. 93). After learning on problem (e) was completed, problem (d) was presented again and

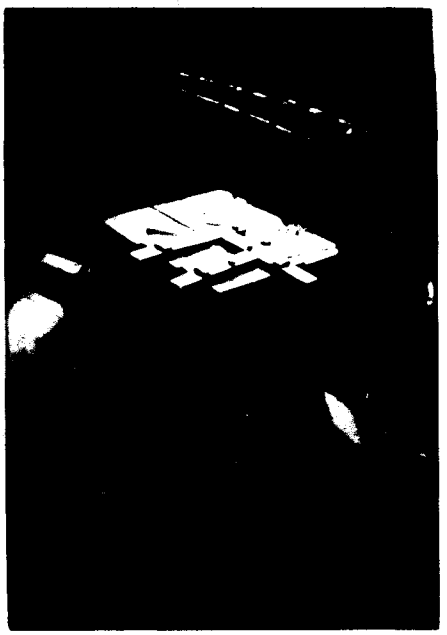


Fig. 7.- Photographic View of the Puzzle-Box, Showing the General Setting of Problem (d) in the Cage of the Gorilla.

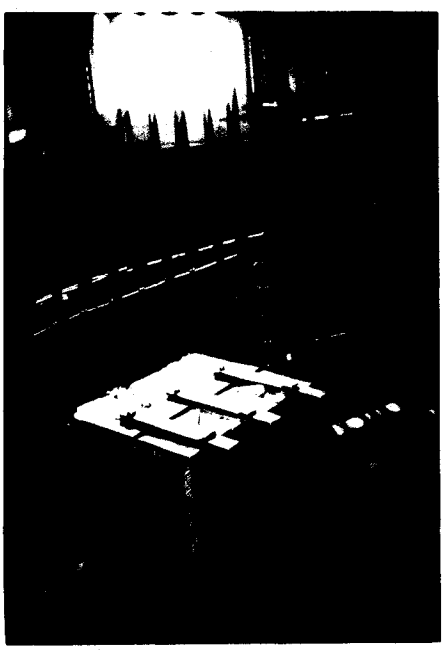
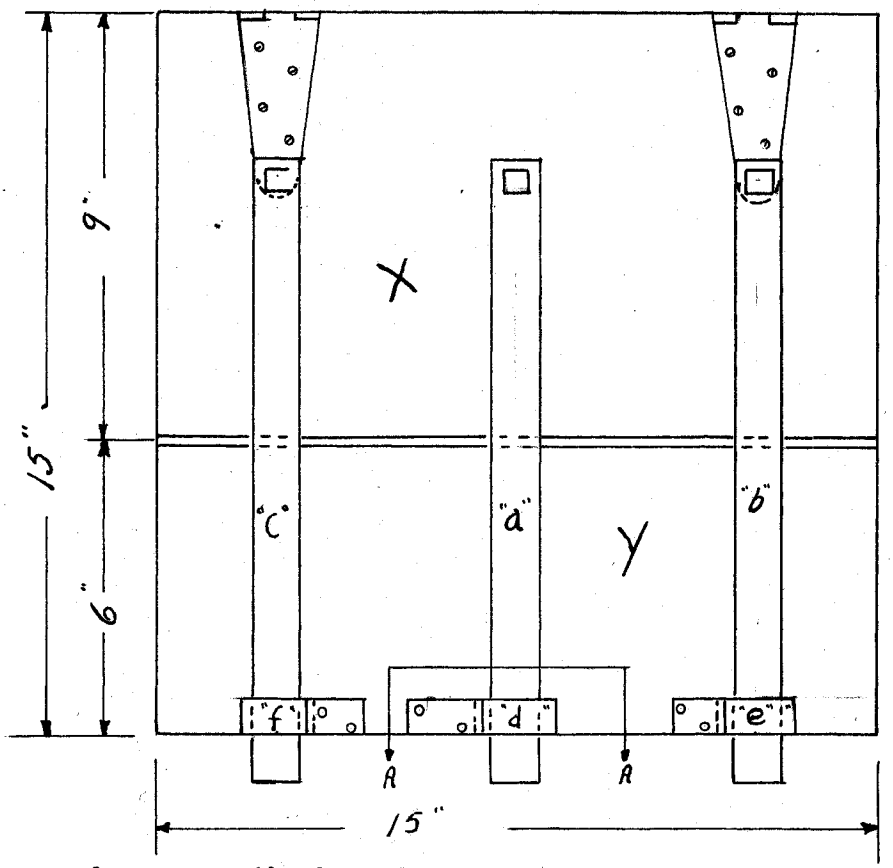
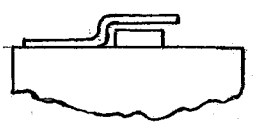


Fig. 6.- Photographic View of the Puzzle-Box, Showing the General Setting of Problem (c) in the Cage of the Gorilla.



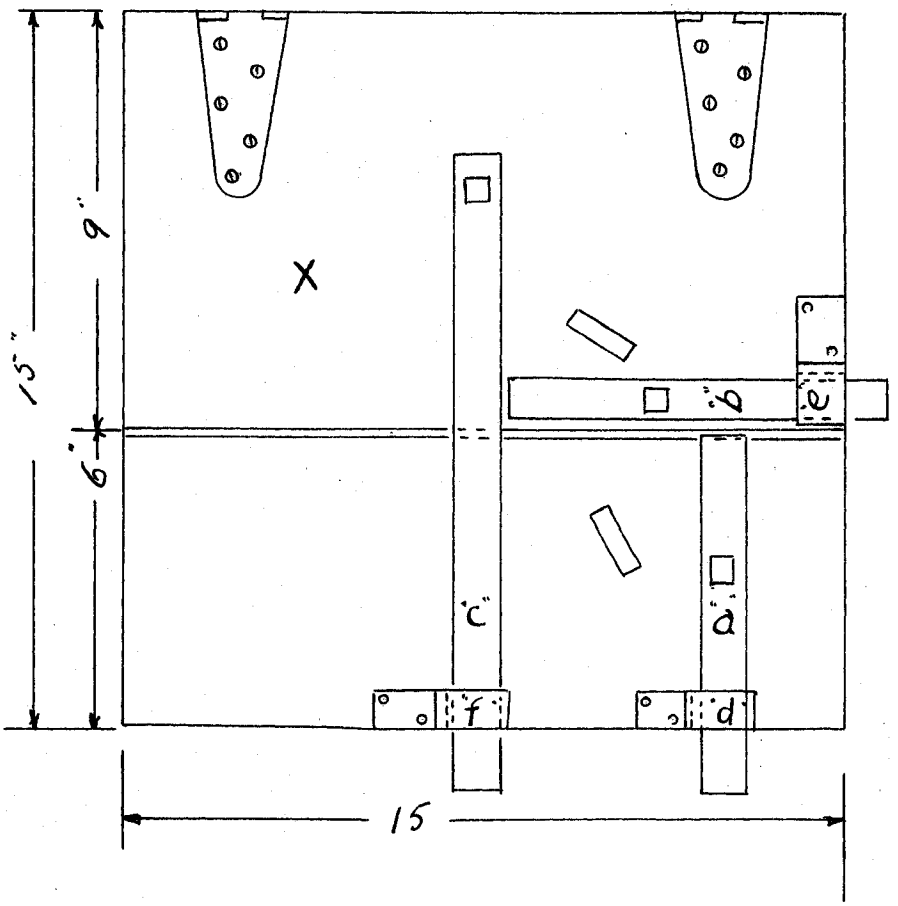
a, b, c, are the bars locking the box;
d, e, f, are the catches;
x is the lid; and
y is the stationary part of the top of the box.

Fig. 8.- Top View of the Puzzle-Box Showing the Lid Locked by the Three Bars as in Problem (c).



SECTION AA
(See section AA of Figure 8)

Fig. 9.- Drawing of the Catch by Means of Which the Bars Were Locked.



a, b, c, are the bars locking the box;
d, e, f, are the catches;
x is the lid; and
y is the stationary part of the top of the box.

Fig. 10.- Top View of the Box Showing the Lid Locked by the Three Inter-Locking Bars, as in Problem (d).

learned.

Before presenting the learning problems themselves Susie was allowed to learn how to open the lid of the box by pulling up on one bar placed in the center of the box. The catch was not on the box at this time. As food did not seem sufficiently to motivate Susie, and as she seemed strongly motivated by the desire to play, a large rubber ball was placed in the box to motivate her to open it. When Susie once obtained the ball she was allowed to keep possession of it for a few minutes during which time she played with it. The keeper stayed in the cage during these experiments. At a signal from the experimenter he obtained the ball from Susie by merely commanding her to give it to him and holding out his hand for it. Susie was then made to sit on a tree stump at the other end of the cage while the ball was placed back in the box by the keeper who kept himself between Susie and the box in such a way that she could not see him re-set the bars.

Criterion of Learning.- The criterion of learning consisted of four successive successes without error. An error was any attempt to move a bar in the wrong direction or an attempt to move a bar out of its proper serial order.

Records.- A time record was kept of each trial, the time consisting of the interval from the instant the subject reached the box to the time the lid was raised. A descriptive account was also kept of the subject's learning behavior.

The Learning Data.-

(a) One bar moving to the right

Trial 1. (January 25) Susie comes to the box immediately and tries to lift up on the bar. She looks through the crack where the lid closes and seeing the ball inside displays an intense desire to get it. She beats on the top of the box, picks at the hinges, chews a corner of the box, then picks at the band around the box. Now, standing in front of the box, she takes hold of the bar with her right hand and moves it back and forth several times, leaving it closed. During this behavior with the bar her eyes are focused on something outside the cage. Accidentally she pushes the bar clear of the catch with her body, but does not notice it. Presently she lifts up on the bar, opening the box. Time: 2 minutes, 10 seconds.

Trial 2. (January 25) She inspects everything about the box, picking at the hinges and the band around the box. She beats on the side of the box. Taking hold of the bar with her right hand, and with her eyes focused on something outside the cage she clears the bar on the catch. Feeling the bar move she immediately looks down and lifts up on the bar, opening the box. Time: 1 minute, 50 seconds.

Trial 3. (January 25) Susie's attention is directed to the bar immediately. With her left hand she tries to push it in the wrong direction. This is attempted several times. Then she shifts to the left corner of the box and taking the bar in her right hand she pushes it clear of the catch. Again she was not looking at the bar when she did this, but immediately looks down and lifts up on the bar. Time: 1 minute, 30 seconds.

Trial 4. (January 25) She attends to the bar immediately. Sitting in front of the box she tries to push the bar in the wrong direction, using her left hand. She then shifts to the left corner of the box and taking the bar in the right hand pushes it clear of the catch and lifts up on it. She was apparently looking at the bar this time. Time: 45 seconds.

Trial 5. (January 25) Coming to the front of the box Susie tries to push the bar in the wrong direction. Each time she tries to push it horizontally she follows this action by trying to pull up on the bar. She now chews on the corner of the box, then taking the bar in her left hand clears it and lifts up on it. Time: 40 seconds.

Trial 6. (January 25) Susie first tries to lift up on the bar. Then quite accidentally she pushes the bar clear with her shoulder. Immediately she sees the new position of the bar and lifts it up. She has apparently learned the advantage of the bar moved. Time: 32 seconds.

Trial 7. (January 27) She tries to lift up on the bar with her right hand. She then beats angrily on the side of the box. She bites at the bar. Then, taking the bar in her right hand she clears it and lifts up. Time: 1 minute, 10 seconds.

Trial 8. (January 27) Taking her position in front of the box she tries to lift up on the bar. She shifts quickly to the left corner of the box and using her right hand pushes the bar clear. Her eyes are not focused on the bar during this process of clearing the bar with the right hand, but feeling the bar move she quickly looks down and lifts up on it. Time: 20 seconds.

Trial 9. (January 27) Susie comes to the front of the box and tries to lift up on the bar with her right hand. She then immediately shifts to the left corner of the box without taking her hand off the bar, and with her eyes focused on something outside the cage, she clears the bar. Looking down immediately she lifts up the lid. Time: 28 seconds.

Trial 10. (January 27) Same behavior as in trial 9. Time: 12 seconds.

Trial 11. Same. Time: 8 seconds.

Trial 12. Same. Time: 22 seconds.

Trial 13. Same. Time: 18 seconds.

Trial 14. Same. An automatism seems to have developed, consisting of the following behavior: coming to the front of the box and trying to lift up on the bar, then moving to the left corner of the box and pushing the bar clear with the right hand. During this process Susie is not looking at the bar, but always looks immediately down when she feels the bar move and then lifts up on it. Time: 27 seconds.

Trial 15. (January 28) Susie comes to the left corner of the box and tries to lift up on the bar. Then she pushes it clear of the catch. She is looking at the bar during this behavior. Time: 12 seconds.

Trial 16. (January 28) She comes to the left corner of the box immediately and with the right hand clears the bar of its catch and lifts up on it. Her eyes are focused directly upon the bar. No errors were made. Time: 5 seconds.

Trial 17. (January 28) Same as in trial 16. Time: 4 seconds.

Trial 18. (January 28) Same. Time: 4 seconds.

Trial 19. (January 28) Same. Time: 5 seconds.

(b) Two bars moving to the right

Trial 1. (January 29) Taking her position in front of the box Susie attacks first the new bar which she clears of its catch. She then clears the other bar and lifts up on it, opening the box. She uses her right hand during this process and her attention is directed toward the bars. There were no errors. Time: 7 seconds.

Trial 2. (January 29) Same as in trial 1. Time: 3 seconds.

Trial 3. (January 29) Same. Time: 3 seconds.

Trial 4. (January 29) Same. Time: 4 seconds.

(c) Two bars moving to the right and one bar moving to the left

Trial 1. (January 29) Susie clears bar "a" and then bar "b" and immediately attacks the new bar - bar "c" (see Figure 8, p. 92). But she tries to push bar "c" in the wrong direction; that is, in the same direction in which she had learned to push the other bars. She returns to the other bars and moves them as far to the right as they will go and then tries to lift up on bar "a". She now returns to bar "c" and tries to push it to the right. She moves bars "a" and "b" back and forth and tries to lift up on them. They are left clear. She then pushes bar "c" clear with her left hand, and immediately grasps bar "a" with her right hand and lifts up the lid. Time: 1 minute, 47 seconds.

Trial 2. (January 29) Susie clears bars "a" and "b" with her right hand and tries to lift up on bar "a". She then takes bar "c" in her left hand and clears it. She immediately returns to bar "a" and lifts up on it, opening the box. Time: 15 seconds.

Trial 3. (January 29) She clears bar "b" with her right hand and bar "c" with her left hand almost simultaneously, then clears bar "a" with the right hand and lifts up on it. No errors. Time: 4 seconds.

Trial 4. (January 29) Bars "a" and "b" and cleared with the right hand. She then tries to push bar "c" in the wrong direction and tries to lift up on it. Bar "c" is now pushed correctly and she

lifts up on it, opening the box. This time she used the right hand, to work bar "c". Time: 12 seconds.

Trial 5. (January 29) Clears bars "a" and "b" immediately and tries to push bar "c" the wrong direction with the right hand. Bar "c" is now taken in the left hand and cleared and lifted up on. Time: 6 seconds.

Trial 6. (January 30) She clears bars "a" and "b" correctly with the right hand and tries to move bar "c" in the wrong direction. She immediately moves "c" correctly with the left hand and opens the box. Time: 6 seconds.

Trial 7. (January 30) Susie quickly clears bar "b" with the right hand and bar "c" with the left hand almost simultaneously, then clears bar "a" with the right hand and lifts up on it. No errors. Time: 5 seconds.

Trial 8. (January 30) Same as in trial 7. Time: 5 seconds.

Trial 9. (January 30) Same. Time: 5 seconds.

Trial 10. (January 30) Same. Time: 3 seconds.

(d) First presentation of three inter-locking bars

Trial 1. (February 1) Susie clears bar "a" and tries to push bar "b" in the wrong direction (see Figure 10, p. 93). She tries to push bar "c" in the wrong direction. Bar "b" is opened and then closed. Closes "a", then opens it, closes and open it again. Attempts to push "c" in right direction. Beats on the side of the box. Tries to push "c" in the wrong direction. She now leaves the box for about two minutes. Coming back again she closes and opens again "a". Leaves box for a while and coming back to it sits down on it. She now plays about the cage for some time. Coming back to the box at the end of about seven minutes she beats on the side of the box, tries to push "b" the wrong direction, then pushes it right, clearing it. Now she pushes "c" right direction but not quite clear of its catch, and tries to lift up on it. Lying down on her back in front of the box she beats the side of the box, then taking hold of bar "c" with her foot she pushes it clear of the catch. Quickly she jumps up and lifting up on bar "c" opens the box. Time: 12 minutes, 57 seconds.

Trial 2. (February 1) Susie clears "a" immediately and tries to push "c" in the right direction. She then clears "b" and tries to lift up on "c". Not being able to lift up on "c" she quickly clears it and lifts up, opening the box. Time: 30 seconds.

Trial 3. (February 1) She tries to move "b" the wrong direction. Clears "a". Tries to move "c" the right direction. She now clears "b", closes it, and then opens it again. Clears "c" and lifting up on it opens the box. Time: 56 seconds.

Trial 4. (February 1) Tries to move "b" and "c" in the right direction, then clears "a". Tries to move "c" in right direction. Moves "a" back and forth several times, leaving it clear of the catch. Tries to move "c" the correct way and then tries to lift up on it. Clears "b" and tries to lift up, then clears "c" and lifts up, opening the box. Time: 36 seconds.

Trial 5. (February 1) Susie tries to move "b" and "c" in the correct directions. She now clears "a" and tries to move "c". Tries to push "b" the wrong direction then pushes it correctly, clearing it. She now lifts up on "c", tries to push it the wrong way, pushes it correctly and lifts up on it, opening the box. Time: 47 seconds.

Trial 6. (February 2) Susie clears bar "a" immediately then tries to push "b" the wrong direction, but immediately pushes it correctly. Clears "c" and lifts up on it. Time: 7 seconds.

Trial 7. (February 2) She immediately clears bar "a" and tries to push "b" in the wrong direction. Tries to lift up on "c", then tries to push it the wrong way. She now closes "a", opens it, closes it, and opens it again. She opens and closes "b". She now leaves the box for a while and returning tries to lift up on "b". Bar "a" is now closed and she tries to lift up on "c". She beats angrily on the box and then leaves it for a while. Returning to the box at the end of about three and one-half minutes, she clears "a", tries to lift up on "c", then opens and shuts "a" several times, leaving it closed. Tries to lift up on "b", and opens and closes "a" several times, leaving it closed. She tries to push "c" in the wrong direction. She beats on the box again. Five and one-half minutes have passed and all the bars are now closed. She picks at the hinges and the band around the box, looks outside the cage a while, then clears "a" and tries to push "c" in the correct direction. She beats on the box, then closes "a". She now lies down on the floor and rolls over, accidentally opening "a". She now gets up and opens "b", but closes "a", which again closes "b". She now leaves the box. Eight minutes have passed. She walks about the cage beating her chest and gritting her teeth. She seems very intent upon opening the box but unable to do so. She returns to the box and chews on the corner of the lid. "a" is worked back and forth several times, and left open. She leaves the box and walks about the cage gritting her teeth. She returns soon and closes "a" and beats on her chest. She moves "a" back and forth several times, leaving it open, then tries to lift up on "c". She now leaves the box and interests herself with other things about the cage, occasionally coming to the bars and look-

ing at the experimenter. At the end of about twelve minutes she returns to the box, picks at the hinges, tries to lift up on "c", then leaves the box. At the end of 15 minutes the experiment is discontinued for the day as Susie shows no more interest in trying to open the box.

Trial 8. (February 3) Susie clears bar "a" and tries to lift up on "c". Partly clears "b" and tries to lift up on "c". She now closes "a", thus closing "b" also. She beats on the side of the box, clears "a" and beats on the box again. She tries to lift up on "c". She stands on the box and beats on her chest. She now closes "a" and opens it again, then gets a straw and tries to poke it into the crack through which she can see the ball. She closes and opens "a", and then opens "b". Six minutes have passed. She leaves the box for a few seconds, and returning tries to lift up on "c". She then beats on the box. Accidentally she pushes "c" clear of its catch with her body but does not observe it move. Presently she lifts up on "c" and the lid is raised. Time: 7 minutes, 20 seconds.

Trial 9. (February 3) Susie clears "a" and tries to lift up "c". She gets a straw and pokes it in the crack at the ball. She again tries to lift "c", and being unable to do so beats on her chest, then on the side of the box. She closes and opens "a" again. She leaves the box for a while. Three minutes pass before she comes back to the box, and clears "b", but closes it by closing "a". She opens "a" again, tries to lift up on it, then tries to lift "c". She beats on her chest, then closes "a" again. Beating her chest quite vigorously she walks about the cage for a while. Coming to the side of the cage where the experimenter is standing she looks at him for a while. Susie now plays about the cage for a while without giving attention to the box. A little over seven minutes have passed when she returns to the box and works "a" back and forth several times, leaving it open. She tries to lift up on both "a" and "c". Again she leaves the box and beats on her chest. There are signs of anger as she grits her teeth and beats her chest. At almost twelve minutes she comes back to the box and bites at one corner of the lid, picks at the hinges, and beats on the band around the box. Her behavior now resembles the first reactions to the puzzle-box in that she is attending to all phases of the situation in an entirely random manner. It is evident that up to now she has not acquired any learning of the essential elements in the situation. Yet she continues to be motivated by the situation. The motivation is seen to be waning as she leaves the box more often and stays away longer each time. She is also becoming emotionally disturbed over her lack of success. She closes and opens "a", then opens "b", but closes "b" again by closing "a". She pulls up on both "a" and "c", then leaves the box again. She beats on her chest and grits her teeth in anger, but before long gets interested in playing and apparently forgets about the box. Laying on the floor she plays with her feet, the straw, and anything else that comes within her reach. Several minutes pass and she shows no evidence of interest in trying to open the box. Finally the experiment is discontinued and failure to learn the problem recorded. Time: 18 minutes.

At this point it was thought best to present the subject with problem (e), two-inter-locking bars (see "b" and "c", Figure 10, p. 93). The learning of problem (d) was beyond Susie's present ability. She had succeeded in opening the box several times, and at times in a very short time interval, but the subsequent trials have shown that such successes were merely a matter of accident in the course of random activity. Furthermore, these chance solutions did not affect any learning. Here is a problem which can finally be solved by the subject by chance in the course of random trial and error activity, providing the subject keeps at it long enough. But here is a problem which the subject can solve by chance and never recognize the consequences of those chance acts. It follows that we cannot take solution itself as a criterion of learning.

Why is it that the subject cannot achieve learning in this situation? Can it be that the situation is merely too difficult because the subject lacks past experience with the essential elements concerned in solution, and is unable to acquire that experience in the situation itself? If this is true, then would not the subject readily solve the problem if provided with some past experience relevant to the situation? Problem (e) was given in an attempt to answer this question, with the thought in mind that if Susie solved it, then problem (d) would be presented again.

(e) Two inter-locking bars

Trial 1. (February 4) Susie tries to push "b" the wrong direction, then tries to lift "c". Returning to "b" she pushes it clear, then tries to lift "c". She then pushes "c" correctly and lifts up on it, opening the box. Time: 12 seconds.

Trial 2. (February 4) She tries to push "b" the wrong way, then pushes it correctly. Immediately she clears "c" correctly and lifts up on it. Time: 4 seconds.

Trial 3. (February 4) Taking "b" in her right hand and "c" in her left hand she clears them almost immediately, and lifts up on "c" immediately. No errors. Time: 6 seconds.

Trial 4. (February 4) Same as in trial 3. Time: 5 seconds.

Trial 5. (February 4) Same. Time: 4 seconds.

Trial 6. (February 4) Same. Time: 5 seconds.

(f) Second Presentation of Three Inter-locking Bars

Trial 1. (February 5) Susie tries to lift up on "c" then clears "a" with the left hand and clears "b" and "c" simultaneously as before in the two inter-locking bar problem. Lifts up immediately on "c". Time: 4 seconds.

Trial 2. (February 5) Susie pulls at "b" with her right hand and "c" with her left hand simultaneously. Then she clears "a" with her right hand, and pulling at "b" and "c" as before clears them, and opens box by pulling up on "c". Time: 6 seconds.

Trial 3. (February 5) Using only her left hand, as she braces herself with the right hand on the floor, Susie clears the bars in order with no errors and lifts up on "c". Time: 5 seconds.

Trial 4. (February 5) Bar "a" is cleared with the right hand, then bar "b" with the right and bar "c" with the left hand. Bars "b" and "c" were cleared simultaneously. No errors. Time: 3 seconds.

Trial 5. (February 5) Same as in trial 4. No errors. Time: 4 seconds.

Trial 6. (February 5) Same. Time: 4 seconds.

Interpretation.- If a problem can be solved immediately and without overt trial and error movements, in the absence of past experience with the essential elements concerned in the situation, then we might well expect the first simple problem (a) to be solved

in that manner. But that problem was solved quite otherwise. The first response was merely in terms of past experience; that is, lifting up on the bar as she had learned to do previously. When that response was futile Susie resorted to random trial and error activity, during which behavior the bar was cleared of the catch and locked time and time again. The bar just happened to be clear of the catch when she lifted up on it, opening the box. She had not cleared the bar purposively. Again in the second trial Susie did not clear the bar purposively, but was looking outside the cage when by chance she cleared it. From trials three to ten Susie learned a way to open the box, which way continued as an automatism from trials ten to fifteen. This automatism with its erroneous acts was not broken until Susie looked at what she was doing in the fifteenth trial. From then on the box was opened without errors. But in no instance can we say that Susie first saw what to do and then did it in the absence of past experience.

Learning in problem (b) seems to satisfy the criterion of insight respecting immediate learning. Susie immediately attacked the new bar and worked it consistently without errors. But we need not assume insight as explanation. This new bar was simply a duplication of the former one which she had learned to operate. Susie merely transferred bodily her learning on the former bar to this identical new bar. Immediate solution, then, is seen to be a function of the transfer of past experience.

The above explanation of immediate learning as the result

of the transfer of past experience is definitely proved by the results of problem (c). In problem (c) there was a new element added; namely, the new bar moved in the opposite direction. First, Susie reacted to this new bar in the light of her past experience. Had the bar moved in the same direction as the other two which she had previously learned to work, there would undoubtedly have been immediate learning by means of the transfer of experience. But since the bar had a new element to be learned and could not be solved on the basis of past experience alone, Susie resorted to trial and error activity. In the course of this trial and error activity she chanced to push the bar in the correct manner. Several repetitions of this chance solution were necessary to effect learning. It may be concluded from this that immediate solution is a function of a great amount of relevant past experience which is transferred to the new situation, while trial and error activity is a function of no, or a small amount, of such transfer.

Susie's opening of the three inter-locking bars in the first presentation (d), and her achieving of success in a comparatively brief time interval, and then utterly "going to pieces," presents some interesting learning phenomena. It cannot be assumed that true learning has taken place until all errors are eliminated, and the perfect solution is repeated for a series of consecutive trials. It follows that solution itself cannot be taken as a criterion of learning, but rather, repeated solutions without errors. Susie was solving her problem but she did not know how she was solving it. Solution was being achieved by pure chance when her random acts happened to come

luckily in the proper order. However these chance successes did not effect learning and in the last trial of the first presentation of problem (d) behavior was as much a matter of chance as in the first trial. The several solutions accomplished, and the short time interval of many of them, cannot, therefore, be taken as significant. Several successive solutions without error and in a short time, as called for by the criterion of learning, are possible only upon recognition of the consequences of these chance acts. It is this alone which we can term learning.

The question, then, is raised: how did this learning finally take place? The answer is that it was gradually achieved by trial and error activity and the transfer of past experience. The reason that Susie could not learn the problem of the three inter-locking bars was that she lacked sufficient past experience with the essential elements in the situation. This lack of past experience made the problem too complicated for her. But the learning of this complicated problem was made possible when once she had learned to open the box with the two inter-locking bars, problem (e). Equipped with the experience gained in learning problem (e), when Susie was again confronted with the more difficult problem (d), she transferred that past experience to the complicated problem and readily learned it.

No theory other than the trial and error theory of learning is needed to explain learning in this case. Here was a problem which could not be originally solved by trial and error activity alone, but which was finally solved by trial and error aided by the transfer of past experience.

There are four stages in the behavior exhibited in the learning of these problems: (1) learning by trial and error activity where there is little, or no, past experience to transfer to the situation, but where the problem contains few elements to be learned; as in problem situation (a); (2) immediate learning without overt trial and error activity made possible by a large amount of transfer of past experience to a problem which was extremely similar; as in problem (b); (3) failure to achieve the learning of a problem consisting of many new elements to be learned, due to the fact that the problem was too complicated because of little significant past experience which could be transferred, and due to the fact that the subject failed to acquire that experience in the course of trial and error activity in the course of chance solution; as in problem (d); and (4) the learning of a problem by trial and error and the transfer of past experience, which problem was previously beyond the ability of the subject to learn by trial and error alone; as the learning of problem (d).

The first response to the puzzle box was to the box as a whole. In situation (a) Susie responded to everything about the box, to the catches, to the hinges, to the iron band around the box, to the bars - all these things were responded to about equally. In so far as this was true we may say that the subject reacted to the situation as a whole, but the subject so reacted simply because she lacked any learning of what constituted the essential elements in the situation. However, these elements were reacted to, more or less, one by one, and when chance acts in the course of this random behavior

achieved solution while she was attending to a certain element, that element tended to receive attention in the subsequent trials while the other elements tended to be neglected. Response to the situation as a whole was a function of the lack of experience with the essential elements in the situation. Learning itself took place analytically as trial and error activity revealed these essential elements. It follows that response to the situation as a whole cannot be taken as a valid criterion of insight since such response simply indicates that stage of behavior which is prerequisite to learning as such.

Summary.-

1. The gorilla succeeded in opening a puzzle-box in the following problem situations: (a) the box locked by means of one bar which cleared by moving it to the right; (b) looked by means of two bars cleared by moving them to the right; (c) locked by three bars - two cleared by moving them to the right, and one cleared by moving it to the left; (d) locked by means of two inter-locking bars which had to be moved in a serial order; (e) locked by means of three inter-locking bars which had to be moved in a serial order.

2. Immediate solution took place only in the case of the two bars which were cleared by moving them to the right. In this problem the second bar alone was new and it was a duplication of the former which had already been learned. This immediate, errorless solution was made possible by the transfer of experience. Hence the concept of insight is not necessary for explanation as to the mode of learning.

3. Whenever a situation presented a radically new aspect the subject resorted to overt trial and error movements as the method of solution. When the situation, as in the case of the first presentation of the three-inter-locking bar problem, was too complicated such a method was ineffective to achieve learning. By "too complicated" we mean that the subject did not have sufficient past experience to transfer to the situation. When the problem had been made less complicated, by furnishing that experience (as by the learning of the two inter-locking bar problem) learning was readily achieved. Thus a problem which was beyond the ability of the subject to learn by trial and error, was later learned by trial and error aided by the transfer of experience.

4. Chance played an important part in learning to manipulate effectively these bars. Here was a problem which could be solved mentally, but such was impossible except on the basis of past experience. The subject lacked that past experience but acquired it readily by chance in the course of random manipulation. There is no need to assume insight as prerequisite or fundamental to chance in these experiments, rather, insight as a fact of learning was a product.

5. Response to the situation as a whole does not indicate insight learning, but indicates merely that the subject has not yet learned the essential elements constituting the problem. Learning took place analytically in the course of trial and error activity.

Puzzle-Box Problems with the Chimpanzee

Experimental Situation and Procedure.- These puzzle box problems with the chimpanzee are a duplication of the puzzle box

problems used with the gorilla (see p. 89). The same puzzle-box, with its several variations, was used and the order of procedure was the same. (For a description of the box and the experimental procedure see pp. 89-93).

Problem (d) was presented before problem (e) in the case of the gorilla, because the experimenter judged that the subject could learn this complex problem without having first learned problem (e). This error in judgment turned out to be a fortunate one, however, as it resulted in furnishing much significant data concerning the effect of the transfer of past experience on the solution of difficult problems. The same order of presentation of the problems was planned with the chimpanzee, so that the learning of the two subjects might be compared on identical problem situations. However, since the chimpanzee learned problem (d) on the first series of presentations, there was no need to present problem (e).

Food was used to motivate learning in the chimpanzee as it proved to be a much stronger and more consistent motive than the ball.

The same records were kept as in the experiment with the gorilla, the criterion of learning, errors, etc., being identical. (For a discussion of these see p. 94.)

The Learning Data.-

(a) One bar moving to the right

Trial 1. (January 30) Romeo immediately tries to lift up on the bar as he has learned to do formerly. When this fails to open the box he climbs upon the box and begins to pick at the hinges, then climbs down and picks at the band around the box. Again taking hold of the bar he tries to lift it up, then begins jerking at it vigorously. During this latter behavior he chances to pull the bar somewhat to the right so that it moves clear of the catch and the lid raised. Immediately he opens the box. Time: 56 seconds.

Trial 2. (January 30) His attention is directed immediately to the bar. He first tries to lift the bar up, then he picks at the band around the box. Taking the bar in his right hand he moves it back and forth several times slowly, then when it is clear of the catch lifts up on it, opening the box. Time: 31 seconds.

Trial 3. (January 30) Romeo first tries to lift up on the bar. He then picks at the hinges on the lid and the band around the box. He climbs upon the box, then gets down and chews at a corner of the lid. Leaving the box he walks about the cage for a while. After about a minute away from the box he returns and taking the bar in his left hand he clears it of the catch, but does not attempt to lift it up. He chews for a few seconds at the corner of the lid, then lifts up on the bar, opening the box. Time: 3 minutes, 10 seconds.

Trial 4. (January 30) Immediately he tries to lift up on the bar, then moves the bar about halfway clear of the catch and tries to lift up on it again. He then chews at the corner of the lid, and picks at the hinges on the lid. Again, taking hold of the bar he pulls up on it but in such a way that it is also moved the rest of the way clear of the catch so that the box is opened. Time: 58 seconds.

Trial 5. (January 30) Romeo immediately tries to lift up on the bar, then very slowly he moves it clear of the catch and lifts up on it. Time: 12 seconds.

Trial 6. (January 30) He moves the bar to the right correctly and opens the box immediately. No errors. Time: 9 seconds.

Trial 7. (January 30) Same as in trial 6. Time: 7 seconds.

Trial 8. (January 30) Same. Time: 5 seconds.

Trial 9. (January 30) Same. Time: 4 seconds.

(b) Two bars moving to the right

Trial 1. (February 1) Romeo tries to push bar "b" the wrong direction, then clears "a" correctly. Returning to "b" he pushes it back and forth several times, then when it is clear of its catch lifts up on it, opening the box. Time: 45 seconds.

Trial 2. (February 1) He clears "a" immediately and tries to lift up on it, then clears "b" and returning to "a" lifts the lid. Time: 35 seconds.

Trial 3. (February 1) Romeo, using only the left hand, clears first "a", then "b" and opens by lifting up on "a". No errors. Time: 10 seconds.

Trial 4. (February 1) Same as in trial 3. Time: 7 seconds.

Trial 5. (February 1) Same. Time: 11 seconds.

Trial 6. (February 1) Same. Time: 4 seconds.

(c) Two bars moving to the right, and one moving to the left

Trial 1. (February 2) Romeo clears "a" and then "b" with no errors, and immediately tries to push "c" in the same direction. He moves "a" and "b" back and forth several times, leaving them clear of their catches. Taking hold of "c" he first tries to lift up on it, then he pushes it correctly and returns to "a" to lift up the lid. Time: 48 seconds.

Trial 2. (February 2) He clears "a" and tries to lift up on "b". Then he clears "b" and tries to lift up on it again. Then he tries to move "c" in the wrong direction but immediately moves it correctly and returning to "a" opens the box. Time: 28 seconds.

Trial 3. (February 2) Clearing "a" and "b" with the left and right hands respectively almost simultaneously, he then tries to lift up on "a". He then goes to "c" and moving it correctly lifts up on it and opens the box. Time: 20 seconds.

Trial 4. (February 2) Hanging from a rope which is just above the box he pushes "a" and "b" open with his feet, then gets down and tries to lift up on "a". Immediately he leaves "a" and clearing "c" correctly he lifts up on it, opening the box. Time: 40 seconds.

Trial 5. (February 2) Romeo attacks "c" first this time, clearing it correctly, then pushing "a" and "b" open, lifting up on the latter, opening the box. No errors. Time: 8 seconds.

Trial 6. (February 2) Same as in trial 5. Time: 14 seconds.

Trial 7. (February 2) Romeo pushes "a" and "b" correctly and tries to lift up on "a". Then he tries to lift up on "c", but immediately pushes "c" clear on its catch and lifting up on it, opens the box. Time: 16 seconds.

Trial 8. (February 2) He clears the bars with no errors in the following order: "c", "a", "b". Time: 12 seconds.

Trial 9. (February 2) Same as in trial 8. Time: 28 seconds.

Trial 10. (February 2) Same. Time: 16 seconds.

Trial 11. (February 2) Same. Time: 32 seconds.

(d) Three inter-locking bars

Trial 1. (February 4) Romeo clears "a" immediately, then tries to move "c" in the correct direction, and follows by trying to lift up on it. He now returns to "a" and moves it over as far as it will go to the right, and returning to "c" tries to move to the right again. He then tries to lift up on "a". He apparently has not noticed "b" on the side of the lid. He leaves the box for a while. Returning to the box he moves "a" back and forth several times, leaving it open, then tries to lift up on "c". He whines a little and leaves the box and walks about the cage. Coming back to the box he approaches it from the right and notices "b". He tries to lift up on "b", then tries to push it in the wrong direction. Moving to the front of the box he tries to push "c" first in the right, then in the wrong direction. Thentaking hold of "b" he pulls it toward him, clearing it of the catch. He then tries to lift up on "a". When this fails he returns to "c" and first tries to lift it up, then moves it correctly and lifts up on it, opening the box. Time: 3 minutes, 32 seconds.

Trial 2. (February 4) Immediately Romeo clears "a" and tries to move "c" correctly. Returning to "a" he tries to lift it up. When this fails he moves "a" back and forth several times, and then tries to move "c" again and lifts up on it. Then suddenly he notices "c" and first tries to push it the wrong direction, then pulls it toward himself, clearing it. Immediately he tries to lift up on "c", then moves it correctly, and opens the box. Time: 1 minute, 46 seconds.

Trial 3. (February 4) Romeo approaches the right side of the box and tries to move "b" in the wrong direction, then tries to lift it up. Shifting around to the front of the box he tries to move "c" correctly, then moves "a" clear and lifts up on it. Returning to "c" he again tries to push it the right direction. Then taking hold of "b" he pulls it toward himself, clearing it. Immediately he tries to lift up on "a", then clears "c" and lifts up on it, opening the box. Time: 40 seconds.

Trial 4. (February 4) Coming to the front of the box Romeo tries to push bar "b" the wrong way, then pushes it correctly. He then clears "a" and tries to lift up on "c". He works "a" back and forth several times, thus shutting "b". Bar "a" is left open. He then pulls "b" open, and immediately goes to "c" clearing it and lifting the lid up. Time: 35 seconds.

Trial 5. (February 4) Romeo immediately tries to pull "b" the correct direction. He seems to have learned the way in which it

will move but has not yet learned the serial order of moving the bars. He then clears "a", and then tries to move "c" the correct direction. Returning to "a" he moves it over as far as it will go. Taking hold of "b" he pulls it toward himself, clearing it. Immediately it attacks "c" clearing it and lifting up the lid. Time: 33 seconds.

Trial 6. (February 4) Coming to the front of the box he tries to pull "b" toward him, then quickly he shifts his hand to "a" and clears it. Returning to "b" he clears it, then tries to lift up on "a". He then clears "c" and opens the box by lifting up on "c". Time: 25 seconds.

Trial 7. (February 4) Romeo approaches the box at the right corner and clears "a" with the left hand and "b" with the right hand. This is done almost simultaneously. He then shifts to the front of the box and clears "c", opening the box by lifting up on it. No errors. Time: 16 seconds.

Trial 8. (February 4) Coming to the front of the box he tries to pull "b" open correctly, then clears "a" and returning to "b" clears it. Immediately he clears "c" and lifts up on it. Time: 9 seconds.

Trial 9. (February 4) Romeo immediately clears "a", then opens "b" by pulling it toward him, and then clears "c", lifting up on "c" to open the box. No errors. Time: 10 seconds.

Trial 10. (February 4) Same as in trial 9. Time: 9 seconds.

Trial 11. (February 4) Same. Time: 10 seconds.

Trial 12. (February 4) Bars "a" and "b" are cleared almost immediately with the left hand and right hand respectively, while Romeo is at the right corner of the box. Quickly he shifts to the front of the box and clears "c" with his left hand and opens the box by lifting up on it. No errors. Time: 12 seconds.

Interpretation.- All learning exhibited in these problems was clearly that of overt trial and error. At no time did the subject first perceive what to do and then do it. The first responses to the puzzle-box were in terms of past experience; that is, at the beginning of trial 1 in problem (a) the subject first lifted up on the bar as he had previously learned to do. When this response in terms of past experience failed to achieve solution the subject resorted to trial

and error. During this trial and error behavior a certain chance act moved the bar clear of the catch. The fact that the bar would move in a certain direction and then the lid could be lifted was learned by chance in the course of random trial and error activity. This corresponds with the learning exhibited by the gorilla in the same situation.

Romeo did not so readily transfer learning from problem (a) to problem (b) as did the gorilla, Susie. Although the latter problem might have been solved without overt trial and error movement by means of the transfer of past experience, it was solved by a limited amount of the transfer of past experience plus trial and error activity.

When confronted with the new bar which moved in the opposite direction, problem (c), the chimpanzee responded to this new element in terms of his past experience; that is, he tried to move this new bar in the same direction in which he had learned to move the other two. When this response in terms of past experience failed to achieve solution, he resorted to trial and error activity. Again, a chance act during the course of this random activity moved this bar correctly and thus the new element was gradually learned by the repetition of this chance act in subsequent trials.

Again, the subject attacked problem (d) in terms of his past experience. Bars "c" and "a" in this problem situation were in the same location and moved in the same direction as bars "a" and "b" in the previous problem. From the learning data we note that these two bars were responded to in the same manner in which the two bars

in these same locations had been responded to in the previous problem. By transferring that past experience the subject readily opened bar "a", and would have opened bar "c" had not bar "b" blocked it. The two things which the subject had to learn, then, were; to move bar "b" correctly, and to learn to move these three bars in the correct serial order of "a", "b", and "c". Both of these new elements were learned entirely by trial and error.

Of course the subject's reactions were not wholly random in problem (d) in respect to these new elements to be learned. The subject had already learned certain things about the significance of bars on the box; for instance, that the lid would sometimes open by lifting up on a bar, and that a bar would move horizontally. But the fact that bar "b" had to be moved horizontally before it could be lifted up and that it would move only to the left, or toward him, the subject learned by trial and error. In like manner did the subject learn the serial order of working the bars.

As in the case of the gorilla, all learning took place analytically. The subject responded to the situation as a whole only in the sense that in the beginning the subject, lacking experience with what constituted the essential elements in the situation, responded to all parts of the problem somewhat equally. But even then the subject reacted to certain elements one at a time, and when a certain response to a certain element achieved solution that response tended to be retained and other responses tended to decrease. Learning itself took place analytically, the end result of which was a

synthesis of all the significant elements concerned into the learned response. The subject tended to perceive the situation as a whole and to react to it as a unit at the end of the learning process. It thus follows that perceiving the situation as a whole and reacting to it as a whole is not a cause of learning, but only the end result.

Summary.-

1. The chimpanzee learned to open a puzzle-box locked in the following ways: (a) by one bar which could be unlocked by moving it to the right; (b) by two bars which were to be moved to the right; (c) by two bars to be moved to the right and one to be moved to the left; and (d) three inter-locking bars which had to be moved in a serial order.

2. Although the problems might have been solved mentally without overt trial and error movement, all the new elements in the problems were solved by overt trial and error. In no case did the subject first know what to do and then do it. The first response to a new situation was always in terms of past experience, and when past experience failed to achieve solution the subject resorted to trial and error.

3. As in the case of the gorilla chance acts in the course of this trial and error activity solved the problems and several repetitions of these chance acts resulted in learning.

4. Learning took place analytically, as chance acts in the course of trial and error activity resulted in solution. Learning resulted in a synthesis of these significant elements into a whole.

The grouping of the significant relations of a situation into a whole is thus the outcome, not the prerequisite of learning.

Puzzle-Box Problems with Children

Experimental Situation and Procedure.-

Subjects.- The children used in these experiments were those of the Cincinnati Parkway Day Nursery, at which place the experiments were conducted. The subjects consisted of eight children, five boys and three girls, ranging in ages from two years and six months to seven years and three months.

The Learning Situation.- These puzzle-box problems with the children are a duplication of the puzzle-box problems used with the animals. (For a description of this box see pp.89-93.) The only change in the box was the substitution of a lighter weight lid and bars. This change was necessary as the former lid was too heavy for the younger children, and there was danger of injury if the lid should fall on them.

The experimenter spent several hours on several successive days prior to the experiments playing with the children at the nursery that he might gain their confidence. This succeeded in banishing all shyness in the experimental situation.

Each child was tested individually and on all the problems on the same day, with the exception of Subject A, who failed on problem (d) on several successive days and on each failure was so emotionally upset that further experimentation on each day was impossible.

The experiments were conducted during the period of April 4-9, 1932, the trials being run each morning between nine A.M. and noon.

The experiments were conducted in a room which was situated directly off the general play room at the nursery. This room was 10' x 10'. The child was first taken into this room where the experimenter and child played ball for a few minutes. This play activity was used to motivate learning and the opening of the box itself was treated as a game played with the ball. The box was covered with a cloth during this preliminary period. After playing with the ball for a while the experimenter uncovered the box and called the subject's attention to it (the lid being back and the locking mechanism not visible). The experimenter then said:

"Do you want to play another game with the ball?" The subject having answered in the affirmative, the experimenter continued:

"Then I want you to go out into the other room for a while. I will put the ball in this box. When I call you, come in and see if you can get the ball out of the box. If you get it, we will play ball again."

The subject was sent out of the room each time while the problem was being re-set. As soon as the box was opened and the ball obtained, the experimenter covered the box with the cloth that the subject might not further study the locking mechanism.

Only the experimenter was present in the room during the experiments.

The order of the presentation of the problems was the same

as with the animals (see p. 90). It was necessary to present problem (e) to only subject A, however.

Records.- A time record was kept of each trial, the time consisting of the interval from the instant the subject reached the box to the instant the lid was raised. A descriptive account was kept of each subject's behavior, including any significant thing a subject said during the learning process.

Criterion of Learning.- Four successive solutions without error were taken as the criterion of learning. An error was considered as any attempt to move a bar in the wrong direction, an attempt to lift up on it before it had been moved clear of its catch, or before the lid had been fully unlocked, or an attempt to move a bar out of its proper serial order.

The Learning Data.-

Subject A - Boy, 2 years and 6 months

(a) One bar moving to the right

Trial 1. The first response to the box is an attempt to raise the lid by pulling up on the corner. Failing in this the subject appeals to the experimenter for help but when this fails also he returns to the box and looks through the crack in the top at the ball. He tries to get his fingers through the crack. Quite accidentally the bar is pushed open by his arm. Seeing the bar move he quickly takes hold of it and moves it back and forth several times, leaving it clear of the catch. He now picks at the hinges on the lid for a few seconds, then taking hold of the bar again he pulls on it. There is an exclamation of surprise and joy when the lid comes up. Time: 1 minute, 17 seconds.

Trial 2. The first response this time is to pull up on the bar. When this fails he tries to raise the lid by pulling at a corner. Coming to the experimenter and taking his hand the subject tries to get help. He then walks about the room investigating everything, but soon returns to the box and taking hold of the bar with both hands he lifts up. He lifts up so vigorously that the box is moved a little. When

the box moves, the bar is moved partially clear of the catch. He now looks through the crack at the ball and again pulls on the bar. This time he pulls in such a way that the bar moves clear of the catch and the lid is raised. There is no evidence, however, that he intentionally moved the bar. Time: 1 minute, 32 seconds.

Trial 3. The subject immediately attacks the bar, trying to lift it. Going to the right side of the box (from the front) he tries to lift up on that corner of the lid. He seizes the bar with the left hand and jerks it, and the bar moves clear of the catch as he pulls it toward him. Seeing the lid come up a little he comes to the front of the box and lifts up on the bar, opening the lid. Time: 28 seconds.

Trial 4. He immediately comes to the front of the box and tries to lift up on the bar, then quickly shifts to the right side and pulls the bar toward him, clearing it of the catch. As soon as the bar moves he comes to the front of the box and lifts up the lid. Time: 15 seconds.

Trial 5. Coming to the front of the box the subject lifts up on the bar with the right hand, then takes the bar in his left hand and pushes it clear of the catch. Taking the bar in his right hand again he lifts the lid. Time: 8 seconds.

Trial 6. Coming to the front of the box and using only the right hand he clears the bar and lifts up the lid. No errors. Time: 4 seconds.

Trial 7. He first tries to lift up on the bar, then moves it clear of the catch and lifts up again. Time: 6 seconds.

Trial 8. Using only the right hand he opens the box with no errors. Time: 6 seconds.

Trial 9. Same as in trial 8. Time: 4 seconds.

Trial 10. Same. Time: 4 seconds.

Trial 11. Same. Time: 4 seconds.

(b) Two bars moving to the right

Trial 1. He immediately clears bar "a" and tries to lift the lid. Seeing bar "b" he tries to lift up on it, then returning to "a" he tries to lift it again. The subject comes to the experimenter saying, "Get ball." When this fails he returns to the box and again lifts on "a", then seizing "b" he clears it and lifts up, opening the box. Time: 35 seconds.

Trial 2. This time the subject clears "b" immediately and lifts up on it. He lifts up on "a", then clears it and lifts up again. Time: 14 seconds.

Trial 3. Bar "a" is cleared first, then "b". No errors. Time: 7 seconds.

Trial 4. Same as in trial 3. No errors. Time: 5 seconds.

Trial 5. Bar "a" is cleared and lifted up on, then he clears "b" and lifts up on it, opening the box. Time: 8 seconds.

Trial 6. He clears "b" first, then "a". No errors. Time: 4 seconds.

Trial 7. Bar "a" is cleared first, then "b". No errors. Time: 4 seconds.

Trial 8. Same as in trial 7. No errors. Time: 6 seconds.

Trial 9. Same. Time: 4 seconds.

(c) Two bars moving to the right, one bar to the left

Trial 1. The subject first clears "a", then "b" and tries to raise the lid by lifting on "b". He returns to "a" and pulls up on it, then works it back and forth several times, leaving it clear. He lifts on the lid by taking hold of one corner. Leaving the box he walks about the room for a while. Coming back to the box he notices "c" for the first time, and seizing it he tries to push it the wrong direction and lifts up on it. He works "a" back and forth and lifts on it, then "b" and leaves "b" closed. He works "c" back and forth also, leaving it open. He then lifts on "a", then "b", then clears "b" and lifts up on it, raising the lid. Time: 1 minute, 44 seconds.

Trial 2. Bars "a" and "b" are cleared immediately and an attempt is made to raise the lid by pulling up on "a". He then seizes "c" and first tries to push it the wrong direction, then tries to lift up on it. He works "a" back and forth lifting up on it. Bar "a" is left open. He now works "c" back and forth and lifting up on it and raises the lid. Time: 25 seconds.

Trial 3. He attacks "c" first this time, pushing it first the wrong direction, then right, and lifts up on it. He then clears "a" and "b", lifting up on "b" and opening the box. Time: 12 seconds.

Trial 4. Bars "a" and "b" are cleared, then he makes an attempt to move "c" the wrong direction. When "c" fails to move to the

right he immediately pushes it to the left and lifting up on it lifts the lid. Time: 15 seconds.

Trial 5. Bar "c" is first cleared with the left hand, then "a" and "b" with the right hand. No errors. Time: 7 seconds.

Trial 6. He clears "a" and "b" and lifts up on "b", then clears "c" and raises the lid. Time: 8 seconds.

Trial 7. He clears "c", then "a" and lifts up on "a". Clearing "b" he returns to "a" and raises the lid. Time: 12 seconds.

Trial 8. Bar "c" is cleared with the left hand and "a" and "b" with the right hand. He clears "b" last and lifts up on it. No errors. Time: 5 seconds.

Trial 9. He clears the bars in this order: "c", "b", "a", and lifts up on "a". No errors. Time: 4 seconds.

Trial 10. He clears them in this order: "a", "b", "c", no errors. Time: 5 seconds.

Trial 11. Same as in trial 10. No errors. Time: 6 seconds.

(d) Three inter-locking bars

Trial 1. (April 4) The subject tries to move "c" the right way, then clears "a" and tries to push "b" the wrong direction. He lifts on "a", works it back and forth several times, leaving it clear of the catch. He tries to push "c" in the wrong direction. Coming to the experimenter and taking his hand he tries to lead him to the box. When this fails he returns to the box and lifts up on "b", then tries to push "c" the wrong way, then the right way. He closes "a", then leaves the box and walks about the room investigating other things (2 minutes, 15 seconds). Returning to the box he looks through the crack in the lid. He clears "a", then pulls at "b" lifting primarily up but pulls it toward him enough that it is cleared of the catch. (His position is in front of the box). He then works "a" back and forth several times, leaving it locked. This automatically closed "b" again. Leaving the box he goes to the door and tries to open it (the door leads out into the general play room). He stands at the door for some time, making no effort to get the ball. Finally the experimenter says, "Get the ball," and points to the box. The subject goes back to the box and pushes "a" clear and tries to push "c" the right direction, and tries to lift up on it. He then goes to the door again and tries to open it. The experimenter tries to get him back when it is evident that he is not going to try to get the ball, but there is evidence that he is almost ready to cry. The experiment is thus discontinued for the day, and failure recorded. (5 minutes, 25 seconds had passed)

Trial 2. (April 5) He clears "a" immediately and tries to push "c" the right direction, then tries to lift "c", then "a". He looks through the crack in the top of the box and then jerks vigorously at "a". He comes to the experimenter and tries to enlist his help. When this fails he goes to the door and tries to open it. There is evidence that he is getting emotionally upset, and the experimenter interests him in the watch he holds in his hand, and lets him listen to it tick. Then the experimenter says, "Get the ball" and points to the box. He looks through the crack in the top and while doing so accidentally pushes "b" open. He does not seem to notice "b" move. He lifts up on "a", then "c". He now pushes "c" clear and lifts up on it, opening the box. Time: 2 minutes, 56 seconds.

Trial 3. (April 5) The subject comes to the box more eagerly this time and begins work with rapid movements. From a position at the right corner of the box he quickly clears "a" and tries to pull "c" toward him. He then moves to the front of the box and tries to lift "c", then "a". He works "a" back and forth several times, leaving it clear. He takes hold of "b" with his right hand, but without trying to move it, he shifts to the right side of the box and taking hold of the bar with both hands tries to lift it. He then takes hold of "b" with his left hand and tries to push it first the wrong direction, then he moves it clear of its catch and tries to lift up. He moves around to the front of the box and as he does so he pushes "a" shut with his body. This also closes "b". He tries to push "c" both ways and lifts on it. Suddenly he leaves the box and goes to the door and tries to open it. He appeals to the experimenter to let him go into the other room. The experimenter tries to get his attention away from the door by letting him listen to the tick of the watch, etc., but to no avail. He is determined to go out into the play room. It is evident that he will not work at the box any longer and that he is going to cry if not allowed to go out into the play room, so the experiment is discontinued for the day. (4 minutes, 42 seconds had passed).

Trial 4. (April 6) It was not without some coaxing that the subject was enticed into the experimental room this morning. The experimenter played ball with him for some time before he seemed at home in the room. The box was not attacked with much interest, however. He readily clears "a" and tries to clear "c" and then tries to lift it. He then seizes "b" and pulling it toward him (his position being at the front of the box) clears it. He lifts up on "a", then works it back and forth. This closes "b". He leaves "a" clear. He tries to push "c" back and forth as he has "a". He now takes hold of the corner of the lid and tries to raise it. Leaving the box he walks about the room interesting himself with other things. It is some time before he returns to the box (over four minutes have passed). He tries to push "b" the wrong direction, "c" the right way, and lifts on both "c" and "a". Again he goes to the door and tries to open it. When the door will not open he jerks on it and begins to cry. There is no choice but to discontinue the experiment again. (A little over 5 minutes have passed.)

At this point it was thought best to present subject A with problem (e), the two inter-locking bar problem, as had been done in the case of the gorilla which had likewise failed to solve problem (d) on the first series of its presentation. The three inter-locking bar problem was beyond subject A's present ability to learn. He solved it only once in four trials and then merely by accident and that accidental success failed to effect any learning. It may be that in a sufficiently number of trials subject A could have solved the problem upon which he has failed, but there is much evidence to show that he was only being emotionally disturbed by the situation and was rapidly refusing to work at the problem. This same situation developed in the case of the gorilla (see pp. 98-100) but that animal readily learned problem (d) when provided with the experience gained on her learning of problem (e). What had been a problem too difficult for that subject to learn, became learnable when the subject had acquired sufficient past experience which could be applied to the situation. The question naturally suggested itself: would this same transfer of past experience take place and enable subject A to learn this problem? An answer to this question was found by presenting problem (e), and when learning on it was completed, presenting again problem (d).

(e) Two inter-locking bars

Trial 1. (April 7) It was with much reluctance that the subject came to the experimental room this morning. We had played ball for several minutes and he seemed anxious to continue that play. He tries to push "c" the right direction, then tries to lift it. He tries to lift the lid by pulling up on the corner. He picks at a hole in the top of the box where "a" had been bolted, then seizes "b" and pulling it toward him, clears it. Returning to "c" he clears it and lifts the lid. Time: 56 seconds.

Trial 2. He comes to the box more eagerly this time and attacks first "c" which he tries to move both to the right and to the left. He then quickly pulls "b" and returning to "c", lifts up on it, then lifts on "b". Returning to "c" he clears it and lifts up, raising the lid. Time: 36 seconds.

Trial 3. He first tries to push "c" correctly, then pulls "b" open and returning to "c" clears it and opens the box. Time: 10 seconds.

Trial 4. He attacks "b" first, clearing it immediately. He then clears "c" and lifts up. No errors. Time: 6 seconds.

Trial 5. Using the right hand to clear "b" and both hands to clear "c" and lift up on it, he again opens the box with no errors. Time: 5 seconds.

Trial 6. He tries to push "c" the right direction, then quickly shifts to "b" and clears it. Returning to "c" he pushed it clear and lifts the lid. Time: 6 seconds.

Trial 7. He takes hold of "c" first, tries to move it in the right direction, then quickly shifts to "b" and clearning it returns to "c" and pushes it clear and lifts up. Time: 7 seconds.

Trial 8. Very deliberately he takes hold of "b" and clears it before going to "c" which he then clears and lifts on. No errors. Time: 8 seconds.

Trial 9. No errors. Time: 4 seconds.

Trial 10. No errors. Time: 4 seconds.

Trial 11. No errors. Time: 6 seconds.

(f) Second presentation of three inter-locking bars

Trial 1. The subject immediately tries to pull "b" clear, then clears "a" and tries to push "c" correctly. Returning to "b" he pulls it clear of the catch and tries to lift up "a". Shifting to "c" he clears it and raises the lid. Time: 26 seconds.

Trial 2. He tries to clear "b", pulling on it several times, then clears "a" and returning to "b", clears it. He tries to lift "a" and when this fails, returns to "b" and pulls it still farther toward him and away from the catch. Again he tries to lift "a", then suddenly seems to notice "c" which he seizes and clears and lifts the lid. Time: 38 seconds.

Trial 3. Bar "b" is attacked first, but when it fails to move he shifts quickly to "a" and clearing it returns to "b" and clears it. He tries to lift "a", then clears "c" and lifts the lid. Time: 20 seconds.

Trial 4. Again he tries to pull "b" toward him, then quickly shifts to "a", clearing it, and returns to "b". He clears "b" and going to "c", first lifts on it, then clears it and lifts it and the lid. Time: 16 seconds.

Trial 5. He pulls slightly on "b" but goes quickly to "c" and tries to push it correctly. After pushing on "c" several times he clears "a" and returns to "c" and tries to push it again. He now pulls "b" clear, and first lifts on "c", then clears it and lifts again. Time: 30 seconds.

Trial 6. Bar "a" is cleared immediately and then "c" is tried. He quickly shifts to "b" and clearing it returns to "c" and pushing it clear of the catch, lifts the lid. Time: 11 seconds.

Trial 7. Bar "c" is tried first, then "a" and "b" cleared and returning to "c" he clears it correctly and opens the box. Time: 12 seconds.

Trial 8. He attacks "a" first, clearing it, then "b" and "c". No errors. Time: 7 seconds.

Trial 9. He tries to push "c" first, then clears "a" and "b" and lifts up on "a" slightly, shifts to "c" and clears it and lifts up. Time: 11 seconds.

Trial 10. The bars are all cleared without error. Time: 8 seconds.

Trial 11. He takes hold of "c" first but does not seem to try to move it, but shifts quickly to "a" and clears it, then "b" and "c". No errors. Time: 10 Seconds.

Trial 12. Bar "a" is cleared immediately, then "b". He returns to "a" and lifts on it twice, then clears "c" and lifts up the lid. Time: 10 seconds.

Trial 13. He clears "a" and "b" and starts to take hold of "a" again but shifts to "c" which he clears and lifts up on. Time: 8 seconds.

Trial 14. The bars are all moved with no errors. Time: 5 seconds.

Trial 15. No errors. Time: 6 seconds.

Trial 16. No errors. Time: 5 seconds.

Subject B - Girl, 3 years, 7 months

(a) One bar moving to the right

Trial 1. She immediately takes hold of the bar and tries to lift it up, then tries to raise the lid by lifting up on the right corner. She lifts on the bar again. She is standing at the right corner of the box and as she pulls up on the bar it is also pulled toward her, thus clearing the catch and raising the lid. She evidently did not move the bar horizontally and clear of the catch purposively. Time: 28 seconds.

Trial 2. She first lifts up on the bar, then very slowly and deliberately moves the bar to the right clear of the catch and lifts up the lid. Time: 12 seconds.

Trial 3. Immediately the subject clears the bar with no errors. The movements are very rapid this time. Time: 4 seconds.

Trial 4. No errors. Time: 3 seconds.

Trial 5. No errors. Time: 3 seconds.

Trial 6. No errors. Time: 3 seconds.

(b) Two bars moving to the right

Trial 1. Immediately clears bar "a" and tries to raise the lid. Bar "a" is then moved back and forth several times and lifted up on again. Suddenly she sees "b" and clearing it of its catch lifts on it raising the lid. Time: 22 seconds.

Trial 2. She clears "a" immediately and tries to lift it, and exclaims, "It won't come up this way." Moving "a" back and forth several times, she lifts on it again. Then suddenly she seizes "b" and clears it and opens the box. Time: 26 seconds.

Trial 3. She takes hold of "a" and without trying to move it, exclaims, "Oh!". Then she seizes "b" and clearing it, returns to "a" and clears it, opening the box. No errors. Time: 7 seconds.

Trial 4. No errors. Time: 5 seconds.

Trial 5. No errors. Time: 5 seconds.

Trial 6. No errors. Time: 7 seconds.

(c) Two bars moving to the right, one to the left

Trial 1. The subject exclaims upon seeing the box, "What do you have so many of these things on here for?" (pointing to the bars). She then tries to move "c" in the wrong direction (to the right), then clears both "a" and "b" and returns to "c". She tries again to move "c" wrongly, lifts on it, then moves it clear of the catch and lifts up. Time: 19 seconds.

Trial 2. Bars "a" and "b" are cleared, then an attempt made to move "c" the wrong direction. Bar "c" is then moved correctly and the lid raised. Time: 9 seconds.

Trial 3. She tries to move "c" to the right, then clears it and "a" and "b". Time: 11 seconds.

Trial 4. No errors. Time: 7 seconds.

Trial 5. No errors. Time: 4 seconds.

Trial 6. Same. Time: 5 seconds.

Trial 7. Same. Time: 4 seconds.

(d) Three inter-locking bars

Trial 1. She tries to move "c" right, then "b" the wrong direction. Bar "a" is cleared and an attempt is made to move "c". Returning to "b", it is first pushed the wrong way, then cleared. She lifts on "a", then clears "c" and lifts the lid. Time: 33 seconds.

Trial 2. Bar "c" is attacked first. She tries to move it the right way. She pulls at "b". She now clears "a" and tries to push "c" again. Bar "b" is now cleared and then "c". She lifts up the lid by means of "c". Time: 20 seconds.

Trial 3. She clears "a" immediately, then tries to push "c" the right way. She shifts quickly to "b", clearing it, and returning to "c", moves it correctly and lifts up. Time: 12 seconds.

Trial 4. Taking "a" in the right hand and "c" in the left hand, she clears "a" and tries to clear "c". She then moves "b" with her right hand, without taking her other hand off "c". As soon as "b" is cleared she again tries "c" and clearing it, lifts up. Time: 8 seconds.

Trial 5. She pulls at "b", then clears "a", and returns to "b", clearing it. Bar "c" is then cleared and the lid raised. Time: 7 seconds.

Trial 6. She tries to move "c" first (left hand), then clears "a" (right hand) and makes another attempt to move "c". She then clears "b" and returning to "c" clears it. She makes no attempt to lift the lid until all the bars are cleared. Time: 12 seconds.

Trial 7. Using the right hand, she tries to pull "b" correctly, then without letting go of "b", she clears "a" with her left hand, then pulls "b" open. Immediately she clears "c" and raises the lid. Time: 8 seconds.

Trial 8. Using only the right hand, she tries to move "b", then shifts quickly to "a" and clearing it, returns to "b" and moves it correctly. Immediately she goes to "c" and moving it clear of the catch, opens the box. Time: 8 seconds.

Trial 9. She clears the bars with no errors, but tries to lift the lid by means of "a" which is not fastened to the lid, then shifts to "c" and raises it. Time: 10 seconds.

Trial 10. The bars are all cleared with no errors. She lifts the lid by means of "c". Time: 5 seconds.

Trial 11. Same. No errors. Time: 6 seconds.

Trial 12. Same. Time: 4 seconds.

Trial 13. Same. Time: 4 seconds.

Subject C - Boy, 4 years

(a) One bar moving to the right

Trial 1. He tries to lift up the lid by taking hold of the corner. He notices the bar hit the catch, takes hold of the bar and lifts on it. Accidentally his arm hits the bar in such a way that it is pushed clear of the catch. He lifts up on the corner of the lid again and raises it. Time: 14 seconds.

Trial 2. He tries to raise the lid by lifting up on the corner as before, then he pulls at the bar. As he pulls the bar moves. Noticing this he moves the bar the rest of the way, works it back and forth several times, then lifts up on it, raising the lid. Time: 12 seconds.

Trial 3. He works the bar back and forth several times, then lifts it up. Time: 7 seconds.

Trial 4. He lifts on the bar, then moves it clear of the catch and lifts the lid. Time: 5 seconds.

Trial 5. He moves the bar and lifts up the lid with no errors. Time: 4 seconds.

Trial 6. He starts to take hold of the corner of the lid, then seizes the bar and clears it and lifts up on it. Time: 6 seconds.

Trial 7. No errors. Time: 3 seconds.

Trial 8. No errors. Time: 4 seconds.

(b) Two bars moving to the right

Trial 1. He immediately clears "a" and tries to lift up on it. When the lid does not move he tries lifting it by taking hold of the corner. Looking to the experimenter, he says, "I can't get it. You get it." He then goes to the other corner of the box and evidently for the first time sees "b". He seizes it and clears it and lifts up the lid. Time: 17 seconds.

Trial 2. Clearing "a", he lifts on it, then clears "b" and lifts it, raising the lid. Time: 6 seconds.

Trial 3. He clears both bars with no errors. Time: 4 seconds.

Trial 4. No errors. Time: 4 seconds.

Trial 5. He clears "a", then lifts slightly on "b" before he clears it. Time: 5 seconds.

Trial 6. No errors. Time: 4 seconds.

Trial 7. Same. Time: 3 seconds.

Trial 8. Same. Time: 3 seconds.

Trial 9. Same. Time: 3 seconds.

(c) Two bars moving to the right, one to the left

Trial 1. The new bar "c" is attacked first. He attempts to move it in the wrong direction. When the bar does not move he looks at it for a moment, then moves it correctly, then clears "a" and "b". Immediately he lifts up on "b" when he has cleared it last. Time: 11 seconds.

Trial 2. He attacks "c" first, moves it correctly, then clears "a" and "b". No errors. Time: 5 seconds.

Trial 3. Same as in trial 2. No errors. Time: 5 seconds.

Trial 4. No errors. Time: 4 seconds.

Trial 5. No errors. Time: 4 seconds.

(d) Three inter-locking bars

Trial 1. He apparently starts looking for the bar which had previously been on the left corner of the box. He looks through the hole in the lid where the bar was bolted. He tries to push "c" the wrong way, then clears "a", pushes "b" first the wrong way, then the right direction, clearing it. He then clears "c" and lifts the lid. Time: 25 seconds.

Trial 2. He tries to push "c" correctly and when it does not move he leaves it and clears "a", then returns to "c" and tries to move it again, first in the wrong direction, then in both directions. He now clears "b" and returning to "c" tries it again and succeeds in clearing it. Immediately he lifts up the lid. Time: 13 seconds.

Trial 3. Bar "a" is cleared first, then he tries "c" very cautiously, trying to move it in the right direction. When it does not move he quickly clears "b" and returning to "c", clears it and opens the box. Time: 10 seconds.

Trial 4. He clears all the bars and opens the box with no errors. Time: 4 seconds.

Trial 5. He tries to move "b" in the correct direction. He pulls on it several times, then clears "a". Returning to "b" he clears it, then "c". Time: 9 seconds.

Trial 6. Bar "b" is tried again first, but quickly abandoned and "a" cleared. He then quickly clears "b" and "c". Time: 5 seconds.

Trial 7. All bars are cleared with no errors. Time: 4 seconds.

Trial 8. He takes hold of "b" first, but without trying to move it, takes hold of "a" with his left hand, clearing "a" then "b" and lastly "c". No errors. Time: 5 seconds.

Trial 9. He uses the right hand exclusively to clear all bars. No errors. Time: 3 seconds.

Trial 10. Same as in trial 9. Time: 3 seconds.

Subject D - Boy, 4 years, 5 months

(a) One bar moving to the right

Trial 1. He lifts first on "a", then looks at the catch and slowly moves the bar clear and lifts it again. Time: 10 seconds.

Trial 2. No errors. Time: 4 seconds.

Trial 3. No errors. Time: 5 seconds.

Trial 4. No errors. Time: 3 seconds.

Trial 5. No errors. Tome: 3 seconds.

(b) Two bars moving to the right

Trial 1. He clears "a", lifts on it, lifts on "b" and raises the lid by it. Time: 7 seconds.

Trial 2. Bar "a" is cleared and an attempt made to lift it, then "b" cleared and lifted up. Time: 8 seconds.

Trial 3. He clears both bars without an error. Time: 5 seconds.

Trial 4. He clears "a" lifts on it, then clears "b" and lifts on it. Time: 7 seconds.

Trial 5. No errors. Time: 5 seconds.

Trial 6. Bar "a" is cleared and lifted on, then "b" cleared and the lid raised. Time: 7 seconds.

Trial 7. No errors. Time: 4 seconds.

Trial 8. No errors. Time: 6 seconds.

Trial 9. No errors. Time: 4 seconds.

Trial 10. No errors. Time: 4 seconds.

(c) Two bars to the right, one to the left

Trial 1. He clears "a" and "b" and tries to move "c" the same direction, and lifts on "a". He pushes both "a" and "b" over farther and tries to push "c" again the wrong way. He then pushes it correctly and raises up the lid by means of "a". Time: 12 seconds.

Trial 2. Bars "a" and "b"are cleared immediately. He tries to push "c" the wrong way, then pushes it correctly, and opens the lid by pulling up on "a". Time: 7 seconds.

Trial 3. He clears "a" and "b", lifts up on "b", then clears "c" and raises the lid. Time: 7 seconds.

Trial 4. He clears all three bars with no errors. Time: 4 seconds.

Trial 5. Bars "a" and "b" are cleared correctly. He tries to move "c" in the wrong direction, the correctly. As soon as "c" clears the catch he lifts up on it. Time: 6 seconds.

Trial 6. He clears all the bars with no errors. Time: 4 seconds.

Trial 7. No errors. Time: 4 seconds.

Trial 8. He pushes "c" the wrong direction, then correctly. Time: 5 seconds.

Trial 9. No errors. Time: 6 seconds.

Trial 10. No errors. Time: 5 seconds.

Trial 11. No errors. Time: 4 seconds.

Trial 12. No errors. Time: 5 seconds.

(d) Three inter-locking bars

Trial 1. He pushes on "c" in the correct direction. When it does not move he pushes on it vigorously. He now clears "a" and tries "c" again. He says, "I can't do it, you do it." He looks to the experimenter. When he sees that he will be given no aid he works "a" back and forth, then suddenly seeming to see "b" for the first time, clears it. He pulls hard on "c" and when it moves so easily, seems surprised. He immediately lifts the lid by means of "c". Time: 18 seconds.

Trial 2. He pushes on "c" easily then much harder. Bar "a" is then cleared and "c" tried again. He then clears "b" and tries "c" again, this time it clears and he immediately lifts up. Time: 13 seconds.

Trial 3. He clears "a" then tries "c", clears "b" and returning to "c" clears it and lifts up. Time: 10 seconds.

Trial 4. All three bars are cleared with no errors. Time: 5 seconds.

Trial 5. He clears "a", pushes slightly on "c", clears "b", and returning to "c" clears it. Time: 7 seconds.

Trial 6. All three bars are cleared with no errors. Time: 5 seconds.

Trial 7. He clears "a", tries to push "c" the right way, clears "b", then "c". Time: 8 seconds.

Trial 8. He clears the bars with no errors. Time: 4 seconds.

Trial 9. No errors. Time: 4 seconds.

Trial 10. No errors. Time: 4 seconds.

Trial 11. No errors. Time: 4 seconds.

Subject E - Girl, 5 years, 4 months

(a) One bar moving to the right

Trial 1. She immediately pushes the bar correctly and lifts the lid. No errors. Time: 5 seconds.

Trial 2. No errors. Time: 5 seconds.

Trial 3. No errors. Time: 3 seconds.

Trial 4. No errors. Time: 3 seconds. When asked by the experimenter if she had ever before opened anything like this the subject shook her head.

(b) Two bars moving to the right

Trial 1. She moves "b"first, then "a", No errors. Time: 7 seconds.

Trial 2. Same as in trial 1. No errors. Time: 5 seconds.

Trial 3. Same. Time: 4 seconds.

Trial 4. Same. Time: 4 seconds.

(c) Two bars to the right, one to the left

Trial 1. She moves "b" first, then "a", and lifts on "a". When the lid does not move, she clears "c" and lifts on "a" again. Time: 13 seconds.

Trial 2. She clears "b", then "a", then tries to move "c" the same direction, but quickly pushes it correctly and lifts up on "a". Time: 8 seconds.

Trial 3. She clears all three bars with no errors. Time: 6 seconds.

Trial 4. Same as trial 2. No errors. Time: 6 seconds.

Trial 5. Same. No errors. Time: 6 seconds.

Trial 6. Same. Time: 5 seconds.

(d) Three inter-locking bars

Trial 1. She clears "a" then tries to push "c" in the correct direction. When "c" does not move she pushes on it harder trying to force it. She pushes "a" over farther, lifts up on it, suddenly seizes "b" and pushes it first the wrong way then correctly. She then clears "c" and lifts on it. Time: 27 seconds.

Trial 2. She clears "a" and "b" and "c". No errors. Time: 10 seconds.

Trial 3. Bar "a" is cleared, then she tries to move "c" then clears "b" and returns to "c" and clears it. Time: 9 seconds.

Trial 4. She clears "a" then moves "b", but not quite clear of the catch. She tries to clear "c" but "b" will not allow it to be fully moved clear of the catch. She lifts on "c". Returning to "b" she fully clears it, then "c". Time: 14 seconds.

Trial 5. Bar "a" is cleared immediately, then she pushes slightly on "c", shifts to "b" clears it, then returns to "c" and moves it correctly. Time: 6 seconds.

Trial 6. She moves all the bars and lifts the lid without an error. Time: 6 seconds.

Trial 7. She clears "a", then "b" and lifts on "a", shifts quickly to "c" and clears and lifts up. Time: 7 seconds.

Trial 8. All the bars are moved and the lid raised with no errors. Time: 5 seconds.

Trial 9. No errors. Time: 4 seconds.

Trial 10. No errors. Time: 5 seconds.

Trial 11. No errors. Time: 5 seconds.

Subject F - Girl, 5 years, 5 months

(a) One bar moving to the right

Trial 1. She immediately moves the bar clear of the catch and raises the lid. No errors. Time: 4 seconds.

Trial 2. Same. No errors. Time: 3 seconds.

Trial 3. Same. Time: 3 seconds.

Trial 4. Same. Time: 3 seconds. When asked by the experimenter if she had ever before opened anything like this, the subject said, "We've got one of them things on our door at our house."

(b) Two bars moving to the right

Trial 1. Bar "a" is cleared first, then "b". No errors. Time: 6 seconds. The subject says, "I know how, don't I?"

Trial 2. No errors. Time: 4 seconds.

Trial 3. No errors. Time: 4 seconds.

Trial 4. No errors. Time: 3 seconds.

(c) Two bars moving to the right, one to the left

Trial 1. Bar "c" is attacked first and moved correctly, then "a" and "b". No errors. Time: 6 seconds.

Trial 2. No errors. Time: 4 seconds.

Trial 3. No errors. Time: 4 seconds.

Trial 4. No errors. Time: 5 seconds.

(d) Three inter-locking bars

Trial 1. She tries to push "c" in the right direction, then clears "a" and tries "c" the same way again. She now clears "b" and tries "c" again. This time "c" clears and she raises the lid. Time: 11 seconds.

Trial 2. She clears "a", then tries to push "c" to the right (correct direction), clears "b" and then "c". Time: 8 seconds.

Trial 3. All bars are cleared with no errors. Time: 5 seconds.

Trial 4. She clears "a" then tries "c", but shifts quickly to "b", clears it, and then clears "c". Time: 8 seconds.

Trial 5. All the bars are cleared with no errors, but she tries to lift the lid by means of "a" (which is not fastened to the lid). She lifts on it several times before going to "c". Time: 12 seconds.

Trial 6. No errors. Time: 8 seconds.

Trial 7. No errors. Time: 5 seconds.

Trial 8. No errors. Time: 4 seconds.

Trial 9. No errors. Time: 4 seconds.

Subject G - Boy, 6 years, 2 months

(a) One Bar moving to the right

Trial 1. He immediately takes hold of the bar and tries to lift it, then moves it clear of the catch and lifts up. Time: 5 seconds.

Trial 2. He pushes the bar clear of the catch and lifts up. No errors. Time: 4 seconds.

Trial 3. Same: No errors. Time: 3 seconds.

Trial 4. Same. Time: 3 seconds.

Trial 5. Same. Time: 3 seconds.

(b) Two bars moving to the right

Trial 1. As soon as he sees the box he says, "You have another one here." He moves this new bar, "b" first, then "a". No errors. Time: 6 seconds.

Trial 2. Bar "b" is moved first, then "a". No Errors. Time: 4 seconds.

Trial 3. He moves "a" first this time. No errors. Time: 3 seconds.

Trial 4. Same. Time: 4 seconds.

(c) Two bars moving to the right, and one to the left

Trial 1. The subject says upon seeing the box, "There's another one of them things on here, isn't there?" He seizes "c" eagerly and tries to push it to the right. When it does not move he stops pushing and looks at the bar then exclaims, "Oh Heck!" He then pushes it clear of the catch, clears "a" and "b" and lifts up the lid. After opening the box he says, "That one (pointing to "c") works different than these others, doesn't it." Time: 6 seconds.

Trial 2. He clears "c" first, then "a" and "b". No errors. Bar "c" is moved slowly, but "a" and "b" very rapidly. Time: 5 seconds.

Trial 3. Same. Time: 4 seconds.

Trial 4. Same. Time: 3 seconds.

Trial 5. Same. Time: 3 seconds.

(d) Three inter-locking bars

Trial 1. He comes eagerly to the box and looks a moment and says, "Gee, you've fixed it all different again." He then attacks the bars working rapidly, trying first "c" in the right direction. When it does not move he tries several times to push it, then clears "a" and tries "c" again, and says, "Something's wrong with this one." He then clears "b" and tries "c" again and opens the box. Time: 11 seconds.

Trial 2. He tries "c" first again, clears "a" and returns to "c". Noticing that "c" hits against the end of "b" he takes hold of "b" at that end and pushes on it. When "b" moves he notices the other end of it move clear of the catch and takes hold of that end to finish moving it. Returning to "c" he clears it and opens the box. Time: 12 seconds.

Trial 3. He first tries to move "c" then clears "a" and taking hold of one end of "b" with the right hand and the other end with the left, he clears it, then clears "c" and opens. Time: 8 seconds.

Trial 4. Bar "a" is attacked first, then "b" moved in the same manner as in trial 3. No errors. Time: 7 seconds.

Trial 5. The bars are all moved with no errors. This time "b" is moved with the right hand only as it is grasped at the end extending out from the box. Time: 4 seconds.

Trial 6. Same. Time: 5 seconds.

Trial 7. Same. Time: 4 seconds.

Subject H - Boy, 7 years and 3 months

(a) One bar moving to the right

Trial 1. The subject immediately moves the bar clear of the catch and lifts up the lid. The right hand is used. No errors. Time: 4 seconds.

Trial 2. Same as in trial 1. Time: 3 seconds.

Trial 3. Same. Time: 3 seconds.

Trial 4. Same. Immediately after solution the experimenter asked the subject if he had ever before opened anything like this, to which the subject replied, "This (pointing to the bar) is like the latch on our gate." Time: 2 seconds.

(b) Two bars moving to the right

Trial 1. The subject attacks bar "b" first and after clearing it, clears "a" and lifts up the lid, the right hand only being used. No errors. Time: 5 seconds.

Trial 2. Same as trial 1. Time: 4 seconds.

Trial 3. Same except that "a" is opened first, then "b" and "b" used to lift up the lid. Time: 3 seconds.

Trial 4. Same as in trial 2. Time: 3 seconds.

(c) Two bars moving to the right, one to the left

Trial 1. Bars "a" and "b" are cleared immediately, then the subject seizes "c" quickly and tries to push it the wrong way and when it does not move exclaims, "Oh!" and immediately pushes it correctly and lifts up the lid by means of "a". The right hand alone is used. Time: 6 seconds.

Trial 2. Bar "c" is attacked first and correctly moved, then "a" and "b" and the lid raised by "b". No errors. Time: 4 seconds.

Trial 3. The bars are cleared in the following order: (with no errors) "c", "a", "b". Time: 4 seconds.

Trial 4. Bar "c" is cleared with the left hand and "b" with the right hand almost simultaneously, then "a" is cleared and used to lift the lid by means of the right hand. Time: 3 seconds.

Trial 5. Same as in trial 4. Time: 3 seconds.

(d) Three inter-locking bars

Trial 1. The subject tries to move "c" correctly, then clears "a" and returns to "c" and tries to move it again. He now seizes "b" and correctly clears it and returning to "c" clears it and lifts the lid. The right hand is used exclusively. Time: 12 seconds.

Trial 2. Bar "a" is cleared immediately, then an attempt is made to clear "c". The subject then returns to "a" and works it slowly back and forth with his attention seemingly directed to how it worked. Suddenly he seizes "b" and clears it and exclaims, "Oh, I see, this one won't let me unfasten that one." (Subject pointing from "b" to "c".) Then he clears "c" quickly and opens the box. Time: 11 seconds.

Trial 3. The bars are cleared in correct order with no errors. The subject says, "I know how to open it now, don't I?" Time: 4 seconds.

Trial 4. No errors. Time: 5 seconds.

Trial 5. Same. Time: 4 seconds.

Trial 6. Same. Time: 3 seconds.

Interpretation.- On the surface the learning data seems to reveal both insight and trial and error learning. There are many cases of immediate solution in the older children. Subjects E, F, and H, immediately opened the box with no errors on problem (a). Subjects D and G made only one error each and that error was probably due to the fact that they were working too rapidly and did not take time to "size up" the situation. Whenever this immediate solution took place on the original problem the experimenter endeavored to ascertain what previous experience that subject had had with similar situations. The questions

which the experimenter asked these subjects resulted in throwing much significant light on the phenomenon of immediate learning. For instance, subject H said that the latch on the gate was similar to the bar on the box. Subject F said that the bar was like a latch or lock on their door. Subject E did not recall having any past experience relative to the problem box, but we may perhaps assume that she had had such past experience. Immediate learning did take place several times, but such immediate learning can very well be explained in terms of past experience. Hence, there is no need to assume that such phenomenon indicates a type of learning behavior which is different from and antagonistic to trial and error.

Immediate learning, made possible by transfer of training, is seen again in problem (b) in the instances of Subjects E, F, G, and H. Here the new bar which was added was a duplication of the first bar, and learning took place by means of immediate transfer. Only subject F succeeded in solving problem (c) without any errors. But Subjects C, G, and H, made only one error each on this problem. The younger children, Subjects A and B, made several errors before learning that the new bar would move only to the left. There was a tendency for the subjects to react to problem (c) in the light of the experience gained on problems (a) and (b). The transfer of this experience at first caused many errors since the subjects tried to move the new bar in the same direction as they had learned to move bars "a" and "b".

There was the tendency on the part of all subjects to resort to trial and error activity when the problem situation became difficult. In the instances of Subjects A and B, this trial and error activity

appeared in the responses to the first problem situation (a) and was prominent in all the other problems (problem (b) least of all since it presented little that was new). In the instances of Subjects G and H this trial and error activity did not appear, to much degree, until problem (d), and then did not last long. From Subject A (two years and six months of age) to Subject H (seven years and three months of age) there was a gradual progression from trial and error activity to immediate learning. The explanation for this fact seems to be in the fact that the younger children have less past experience, while the older children have more past experience to transfer to the situation. Also we may assume that because of a more advanced neural development older children are able to make a better use of that past experience in solving problems by means of mental trial and error. But in either case past experience is fundamental and prerequisite.

We may conclude that pure trial and error activity is a function of a lack of past experience, whereas, a more or less immediate learning is the function of a large amount of such transferred past experience. It follows, then, that immediate learning cannot validly be taken as a criterion of insight learning, if by that we mean to designate a type of learning which is different from and antagonistic to trial and error learning. As far as this phenomenon of learning behavior is concerned, we need only the theory of trial and error and the concept of the transfer of past experience as descriptive.

In the instance of Subject A on the first series of presentations of problem (d), we have a problem which the subject was unable

to learn by overt trial and error activity. Only once did the subject achieve solution and then only by chance. (Success often took place by means of chance, but this chance success failed to effect any learning.) Finally, being unable to learn the problem, the subject became emotionally upset. But Subject A's inability to solve the problem was due to the fact that he lacked sufficient past experience and was unable directly to acquire that experience in the course of trial and error activity in response to the problem situation. But once he had learned problem (e), he transferred that learning to problem (d) and soon learned the latter. Thus, a problem which was at first too difficult to be solved, became solved when the subject was provided with relevant past experience which could be applied to the problem. It follows that we cannot assume that just because a problem is very difficult, yet learned, that it has been learned by insight (if by that we mean insight as a mode of learning). The learning of very difficult problems is made possible only by the transfer of past experience. Learning first originates in trial and error activity, and since situations are more or less alike, learned reactions are continually being transferred from one situation to another. But whenever a learner meets a totally new situation, or aspect in a situation, trial and error is again resorted to.

Chance played a dominant role in the learning process whenever trial and error activity was present. The part which it played can best be seen in the learning of Subjects A and B on problem (a). It was by chance that they learned that the bar locked the box, and that the

bar would move, and move in a certain way. This learning was readily transferred to the other bars in the subsequent problem situations, thus lessening the need for trial and error activity to just the extent of the transfer.

Whenever there was a great amount of trial and error activity at the beginning of a problem, the subject tended to react to all phases of the problem more or less equally. But when chance acts in the course of trial and error activity resulted in success, certain aspects of the problem tended to receive more attention and other aspects tended to receive less attention. Reaction to the situation as a whole merely indicated that the significant aspects of the problem had not yet been learned. Those aspects were learned in the course of trial and error activity. Since the subject reacted to the elements more or less one at a time (even when those elements constituted a relation), learning may be said to have taken place analytically.

There were evidences of mental trial and error in the case of the older children. This is seen especially in the instance of Subject H in problem (d). After reacting in an overt trial and error manner, he paused and studied the situation, then exclaimed, "Oh, I see." But we do not need to assume that here we have a type of learning which is different from trial and error learning. What has happened in this case is that the trial and error has proceeded on the level of the mental, rather than the overt or physical. The fact that it was mental activity makes it no less trial and error. We may also assume that this mental activity was possible only upon the basis of a certain

amount of learning which had been originally acquired in the course of overt trial and error. Thus, mental trial and error is merely a matter of the transfer of past experience, during which process the subject canvasses the repertoire of his past experiences and applies relevant past learnings to the problem at hand. It follows that mental trial and error is not a valid criterion of insight learning, if by that we mean to designate a type of learning that is different and antagonistic to the trial and error theory.

Summary.-

1. The instances of immediate learning can be adequately and more simply described by means of the transfer of past experience, which past experience has presumably been acquired by trial and error. Hence, immediate solution is not a valid criterion of insight learning.

2. Whenever the problem was difficult, the subject resorted to overt trial and error. Such overt trial and error movements were prominent with the younger children but tended to drop out as one ascends the age scale.

3. Overt trial and error activity was a function of the lack of past experience, just as immediate learning was a function of the transfer of such.

4. Chance played a dominant role in learning whenever trial and error activity was present.

5. There was evidence of mental trial and error, but such phenomenon can adequately be described by the trial and error theory. Hence, mental activity per se cannot be taken as a valid criterion of

insight learning.

6. A problem which was beyond the subject's ability to learn de novo, was learned when once the subject was furnished with sufficient past experience which was transferred to the problem. We cannot assume that just because a problem is solved, that it is solved by insight. Such a solution depends upon the transfer of past experience.

Comparative Analysis of Animal and Human Learning

The puzzle-box problems have been duplicated with the gorilla, the chimpanzee, and the children. Some interesting and significant comparisons may now be made. The findings in each instance have been remarkably similar. For direct comparative purposes the animals may better be compared to the younger children. The most striking similarity appears in the instance of Subject A and the gorilla on problem (d). Both failed to learn this problem on the first series of presentations and became emotionally upset. Both learned the problem, however, on the second series of presentations and after they had learned problem (e). These curves of learning for these subjects on problems (d) and (e) are presented in Figure 12, p. 148. The transfer of experience from problem (e) to problem (d) cannot be fully seen and appreciated except by viewing these curves in the light of the descriptive account of the behavior of each subject during the first series of the presentations of problem (d).

The marked trial and error character of the learning of

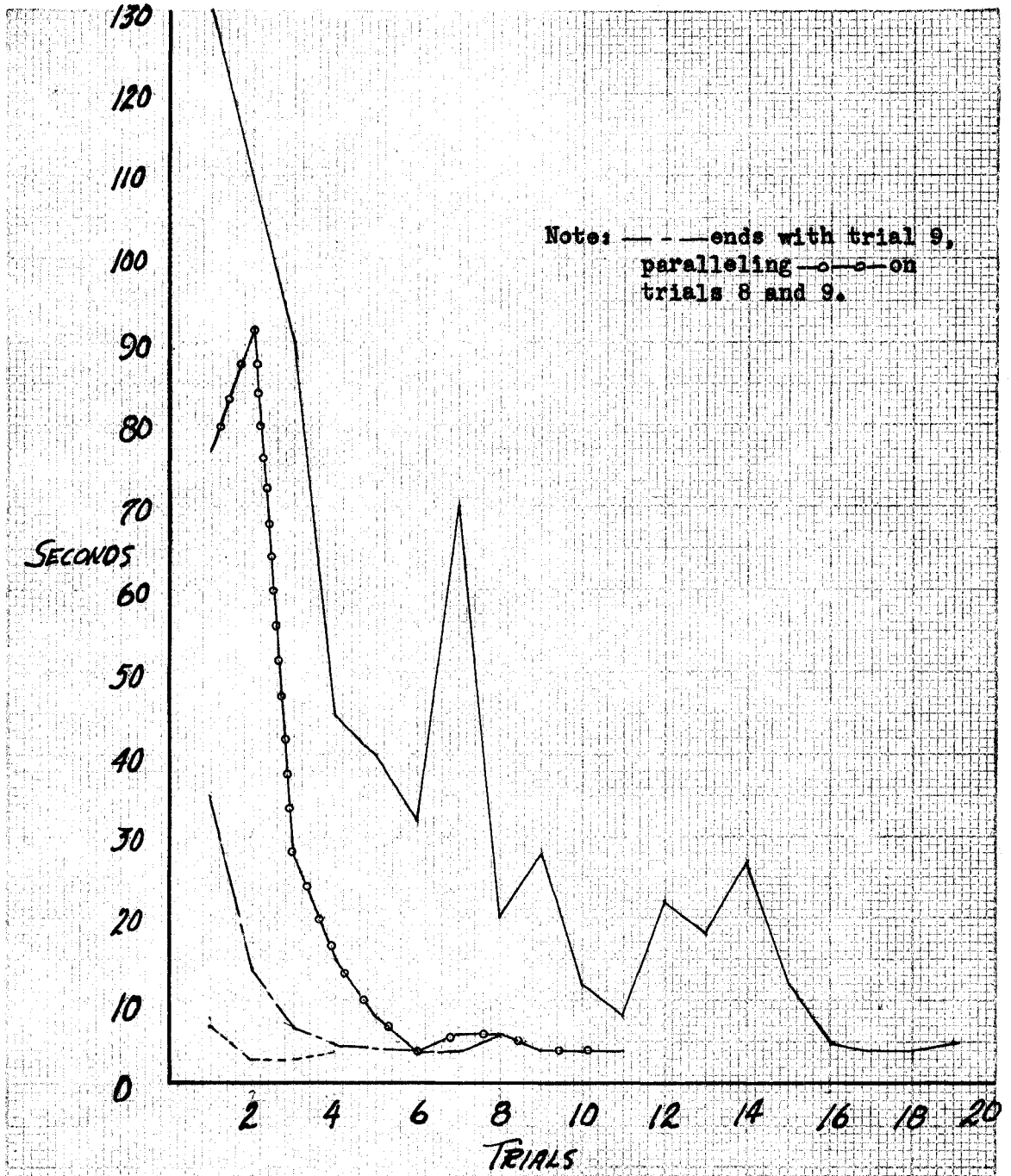


Fig. 11.- Learning Curves of Subject A and the Gorilla Showing Progress in problems (a) and (b), in Terms of Time.

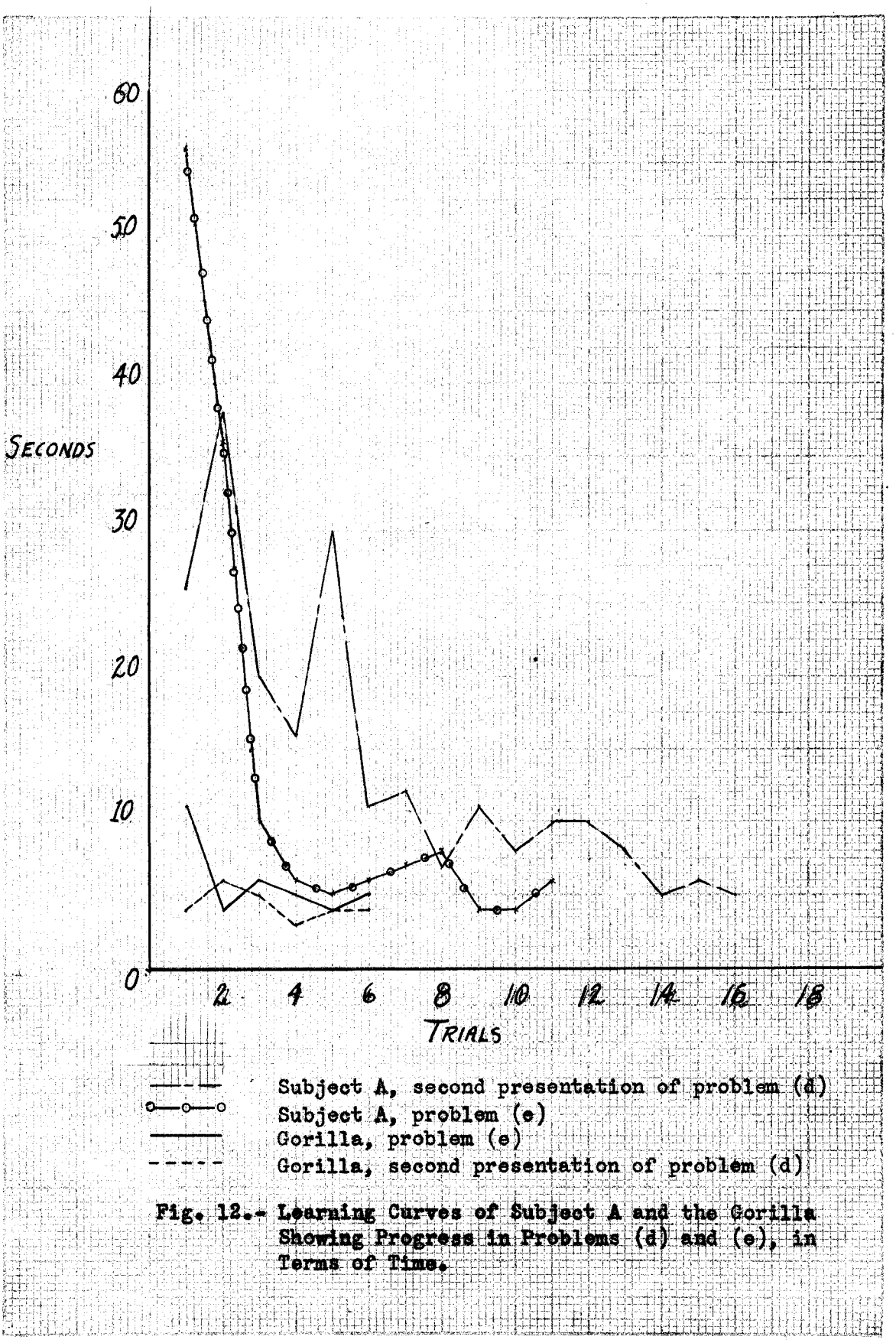


Fig. 12.- Learning Curves of Subject A and the Gorilla Showing Progress in Problems (d) and (e), in Terms of Time.

Subject A and the gorilla is apparent from their respective curves of learning on problem (a). (See Figure 11, p. 147) The transfer of experience (thus gained by trial and error) to problem (b) is quite apparent. The immediate solution without error, in the case of the gorilla, and the much lower time curve, in the case of Subject A, on problem (b) reveal this transfer.

This great degree of similarity in the learning process indicates that one learning theory will adequately describe both human and animal learning. We do not need one set of criteria to describe human learning and another set of criteria to describe animal learning, as some have supposed. (See p.14) Many investigators have been led to assume that we need two learning theories to account for human learning and animal learning, because of the fact that humans use mental trial and error, while animals depend more upon overt trial and error. But even this distinction is one only of degree, as humans use overt trial and error in difficult situations, and it is probably true that the higher animals use a form of mental trial and error wherever they possess a great many associations relevant to the situation. But despite these differences in degree, both types of learning behavior are describable in terms of the trial and error theory.

We may conclude that what appears to be a different kind of learning exhibited in the older children is merely a matter of the transfer of a larger quota of past experiences and the substitution of mental trial and error for overt movements.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Conclusions

From the experimental findings some very definite answers may be derived to the questions which have stimulated this investigation.

1. Learning never takes place immediately when the problem contains any element radically new. Immediate learning takes place only when the learner has a large amount of past experience to transfer to the novel situation. When the problem is in reality new, the learner resorts to trial and error activity. Immediate learning is a function of the transfer of past experience, whereas, trial and error activity is a function of the newness of the problem.

2. Chance plays a dominating role in learning in the sense that the appearance of the adaptive act is unpredictable. The word chance is merely a term to express our inability to make this prediction. This phase of the learning process may best be described by saying that in the course of trial and error activity the learner chances to do certain things which effect solution and result in learning. The assumption of insight as fundamental and prerequisite to such chance acts explains nothing. All that such an assumption attempts to explain

can be described better and more simply by the concept of the transfer of past experience.

3. In older children, and perhaps in the higher animals, trial and error proceeds on the mental level. But mental trial and error is dependent upon previous learning which has been acquired originally by overt trial and error. Both types of learning behavior are adequately describable by the trial and error theory of learning.

4. The perception of and the reaction to the situation as a whole takes place only in the sense that in the beginning stages of learning the learner tends to react to the new phases of the situation more or less equally. But learning itself proceeds analytically, in as much as the learner reacts to these new elements, or relations of elements, more or less one at a time. As chance acts result in success, certain elements, or relations, tend to receive more attention, while others receive less attention. Relations, or associations, in a particular situation are never known a priori of experience. Things become associated together in the contiguity of experience. Such association is the end result, not the cause, of learning. Hence the term insight cannot be used to describe the mode of learning, but merely the end state.

5. From the above facts it may be concluded that the various criteria advanced to describe insight learning are not valid. All the phenomena which these criteria seek to describe are more adequately and simply described by the trial and error theory of learning and the transfer of past experience. The term insight can be used only to describe the fact of learning (the fact that learning has taken place)

and not the process of learning (how learning has taken place).

Educational Implications

The following implications for education are inherent in the above experimental results and their interpretations:

1. Trial and error, whether on the overt or on the mental level, is not to be discouraged, but is to be expected in the learning process. Its absence indicates that the pupil is learning very little that is new to him, but is rather adapting or reacting in terms of his past experience which is sufficient to meet the situation.

2. If desired, the educator, can gradate the unit or units to be learned into several parts according to the degrees of difficulty. The learner may then proceed from the simple to the complex by means of the transfer of past experience with a minimum of trial and error. However, a complete absence of trial and error is not to be expected.

3. Learning situations should be devised so as to stimulate mental trial and error activity, but the educator must realize that such activity is possible only when the learner has been allowed previously to gain concrete experience relevant to the situation. Thinking, or mental trial and error, is to be thought of as the substitution of ideas for acts and as originating and finding expression in overt experience.

4. Synthesis and analysis are to be thought of not as antagonistic but as supplementary processes in the learning act, and even then are not to be considered as entirely separate chronologically. For the sake of motivating the learner the situation may be presented as a

unit, but not too complex de novo. The problem should contain some elements with which the learner has previously had experience. The new elements will then be analyzed out of the total situation when solution in terms of past experience fails. In the course of trial and error activity, their significance for the situation as a whole will emerge. The end result is the synthesis of new experience with past experience. This may mean the complete reorganizing of the latter. The educator should so devise the learning situation and guide the learner as to facilitate this synthetic-analytic-synthetic process which has as its ultimate outcome the reconstruction of experience.

5. The emotional upset which follows the learner's failure to master a situation may build up an aversion to the situation and to all things associated with it. Since such an aversion may be caused not by the learner's real inability to master the situation, but by the educator's failure properly to gradate the material, the school's responsibility looms great. Mental and emotional disturbances may be the direct outcome of the school's failure to adapt the material to be learned to the learner's present ability.

Problems for Further Investigation

In the light of the findings of this investigation the following problems seem worthy of investigation:

1. A study of anthropoid learning behavior from the time of birth to the time of maturity under conditions where all experience can be rigidly controlled. This would leave no room for doubt as to the extent and effect of past experience upon the learning process.

2. A more thorough study of the mental life of the gorilla, Susie, and others of her species. The apparent great individual differences between the gorilla, Susie, and the gorilla, Congo, reveal how little we know about the psychology of this important species of the higher ape group.

3. A comparative study of the genetic development of learning powers in anthropoid apes and children.

4. A comparative study of methods of learning in dull, normal, and superior children.

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APPENDIX

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CERTAIN BEHAVIOR CHARACTERISTICS OF THE GORILLA SUBJECT, SUSIE

The gorilla Susie was captured by a French expedition in the Belgian Congo. At the time of her capture she was estimated to be approximately three months of age. She was taken to France where she was owned by L. Ruhe Company who named her Susi. Later she was taken to Hanover, Germany, and subsequently brought to the United States in the Graf Zeppelin, arriving in this country in August, 1929. J. C. Lucedema became her American owner and Americanized her name to Susie. After an extended tour of the United States for exhibition purposes, Susie was purchased for the Zoological Society of Cincinnati where she is at present. Continously since Susie's arrival in the United States she has been under the care of W. Dressman. It is estimated that Susie is now about six years of age.

This experimental study of Susie is made especially unique by the fact that Susie is the second member of her species to be psychologically studied under experimental conditions. Many interesting facts can be brought to light by a brief comparison of Susie with the gorilla Congo - the subject of Yerkes' experiments.

Yerkes, in his study of Congo, has pointed out that his conclusions must necessarily be tentative due to the fact of individual

differences in every species (50:532). The present study has shown how great these individual differences in the gorilla are. Congo was estimated to be five years of age at the beginning of Yerkes' experiments with her. This makes Congo the same age as Susie during the second year's experiments.

Yerkes has described Congo as an introvert (1:151) and suggests that this trait of character may be characteristic of her species. But Susie may better be described as an extrovert. Whereas Yerkes uses such terms as "reserved, repressed, inhibited" to describe Congo's behavior, Susie was quite the opposite. In every respect she was forward, active, and expressive. During the first year of Yerkes' experiments with Congo he noted the lack of play activity, but notes that this tendency to play had increased by the second year. He says:

> Playfulness was much in evidence, and some of the most favorable opportunities to observe emotional expressions appeared in connection with it. Congo frequently sought opportunity to play with human companions or with the dogs about Shady Nook. From day to day extreme variations appeared, for now she would be active, energetic, frolicsome, eager for play or work as circumstances suggested, and again lethargic, negativistic, and only slightly responsive to playful approaches. (50:508)

But this play activity was so strong and persistent in Susie that it was found to be the most potent and consistent motive in the learning situations. Yerkes used food to motivate learning in Congo, but points out that it was far from an adequate motive. Food as a motive was found very inadequate with Susie. This, however, was due partly to the fact that the experimenter could not obtain full control of the food supply and therefore Susie was not always hungry in the experimental situation. But at no time during the experiments did

Susie fail to respond to the play motive. In the case of the puzzle-box experiments a rubber ball was placed in the box. It had previously been found that Susie was very eager to play with this ball. She would throw it on the floor or against the wall, then run after it, or try to catch it. At times she would place it on the floor and try to stand on it, or roll on her back over the ball. This play activity was usually so strenuous that Susie was not permitted to retain possession of the ball for over a few minutes at a time, as she would utterly exhaust herself. The rapidity with which she would open the box, once having learned how, and the persistence with which she would keep at the box learning to open it, show how eager she was to obtain the ball again that she might resume her play. An attempt was made to motivate learning in the chimpanzee by the play activity but that animal refused to respond to that incentive. The result was that food was used throughout the experiments with the chimpanzee. This difference in motivation may be significant in understanding the psychology of these two animals. Yerkes has pointed out that motivation in Congo was a complex and variable factor in contrast with the simpler forms of motivation in the lower forms of life (2:530). No doubt this high and complex type of motivation in the form of play with Susie reflects a corresponding high biological development.

Yerkes has noted the lack of the tendency toward destruction in Congo (49:138). Boxes, wooden and paper, carpenter's tools, and even a corncob pipe, were placed in her cage at various times. Congo's treatment of these novel articles led Yerkes to say during the first

year's experiments that he would be willing to trust Congo with his best hat. But this tendency toward destruction had greatly increased the next year (50:501). Yerkes suggests that perhaps this change in behavior was a result of the normal psycho-physical development of this animal. The behavior of Susie tends to bear out this suggestion. A steel helmet would be none too safe in Susie's hands. Upon getting hold of anything, the first impulse was to see how quickly it could be torn to pieces. Many experimental situations devised to observe learning behavior in Susie had to be abandoned due to her extreme tendency toward destruction. A cabinet with three doors was once set in Susie's cage in an attempt to study her learning of middle-sizedness, the knobs on the doors varying in size. The doors of the cabinet were promptly broken, while the remainder of the cabinet was rescued from a like fate only with extreme difficulty. Her desire to break things is again seen in the way in which she persisted in tearing the screen wire from the cage in the food and stick problem. This motive toward destruction was at times more potent than was the hunger motive.

Susie again presents a radical contrast to Congo in respect to curiosity. Yerkes says of Congo:

> In the several stick problems it will be recalled that Congo initially paid little or no attention to sticks placed on the floor of her cage, put in front of her, or even handed to her. At first she completely ignored these objects; later she sometimes brushed them aside as if in irritation, and still later she occasionally picked them up, smelled them and either laid them down or for a few seconds carried them about with her. Even though the stick was of unusual color, texture, or shape, she ordinarily displayed little or no interest in it or concern about it. (49:139-140)

Yerkes noted that a year later Congo displayed much more curiosity, but yet far below that of the average chimpanzee of the same age. But Susie's curiosity could hardly be excelled. Any novel article was immediately inspected, and if possible destroyed. In the course of the experiments with the puzzle-box several rubber balls were destroyed by being punctured by her teeth. One of these balls had some green on it. This green immediately attracted her attention. She picked at it, smelled it, then tried to bite it. Evidently she was responding to the green on the ball as if it were food, as she was daily fed various fresh green foods. The stick provided in the food and stick problem was immediately taken in hand and thoroughly inspected. Never for more than a few seconds would she even lay the stick down. Whereas Congo, lacking this curiosity, never learned to use the stick on her own initiative, Susie learned to rake in the food in the course of her trial and error movements with the stick.

Yerkes has associated curiosity and its resulting random behavior with trial and error learning. Thus he associates a lack of curiosity with insight. Accordingly Yerkes ranks the following animals in the order of their use of trial and error as a method of learning: chimpanzee, orang-utan, gorilla; with the reverse order being true of insight learning. Such an association and ranking would not be in harmony with the findings and interpretations of this present study in so far as this study interprets all learning as trial and error in method. Furthermore, there is no evidence from this study to indicate that the gorilla is any less curious than the chimpanzee.