II

THE USE OF IMPLEMENTS

THE situation is made more difficult. The objective in view cannot be reached by making a detour, nor can the body of the animal be adapted to the shape of its surroundings, and thus reach the objective. If the connexion between animal and objective is to be established, it can only be through, and by means of, a third body. This cautious manner of expression is necessary in exposition here; it is only in the case of certain forms of this procedure with third bodies that it is permissible to say that the objective "is secured by means of a tool or implement." This description does not give a correct idea of some ways of overcoming the distance between animal and objective by means of a third object.[1]

If the field of action contains third objects or bodies appropriate for overcoming the critical distance between the animal and its objective the question is: How far is a chimpanzee capable of making use of such objects in the drive to reach the objective?

(1)

The problem is most easily solved when the distance (between goal and animal) is already virtually overcome,

[1] Moreover it is advisable in this whole field to replace stereotyped terms like "use of implements" and "imitation", by phrases which shall be so far as possible exactly descriptive of the animal's actions Those words are clichés which conceal the most important questions under a mask of commonplace. It is far more illuminating to let the animal's behaviour determine one's words, but certainly often more difficult, as there are often no appropriate words in our languages

i.e. when the implement is already "placed" in relation to the goal. The connexion can either be used or ignored, the implement appearing of no interest, and the animal remaining helpless.

In the introduction we saw that Sultan is master of such a situation, although it is not of the simplest type, and the connexion between implement and objective only becomes of account when he climbs a tree. If the experiment is so far simplified that, for instance, a string fastened to the objective is within reach of the animal, then the chimpanzee will almost always solve the problem immediately.

The experiment was made with Nueva on the sixth day of her sojourn at the station (14.3). The objective was at a distance of over one metre from the bars of her cage, and a soft straw was tied to it, lying across the intervening space, which was otherwise empty, right up to the bars. Neuva had hardly seen the objective before she seized the straw and carefully pulled the prize towards her.

Koko had been for five days at the station: (13.7). He was tied by his collar and chain to a tree, so that his range of movement was limited. The objective had been placed on the ground outside this periphery, and a string fastened to the objective was within Koko's reach. He had not seen the preparations. When his attention was drawn to the objective, he glanced at it for a moment, and then turned away; he was again directed towards the edible, seized the string, and drew the objective towards him—only to throw it away after a brief examination: it was not good enough.

Two of the chimpanzees, Tschego and Konsul, had given the same positive results in this experiment (14.2), although in their cases the rope measured *three* metres. The other animals were all confronted with the same problem, in more complicated experiments, and not one of them ever hesitated

to use the rope attached to the objective. And the pulling was always "with an eye on the objective" in the strict sense of the words; one glance at the objective, and the animal began to pull the rope, gazing, not at the rope, but at the distant objective. There can be no possibility that the object of attention was the rope, which for some reason or other was drawn towards the animal.

[*Variation of this Experiment.*

The objective is placed inside a basket; a rope is attached to the handle and leads up to the barred window of the room in which the chimpanzee is kept: the basket is always hoisted up by the rope.]

In a similar situation, a dog would be able to help himself by means of his teeth or forepaws; but the afore-mentioned bitch did not even attempt this simple method of self-help, and paid no attention to the string which was lying just under her nose—whilst at the same time she showed the liveliest interest in the distant objective. Dogs, and probably, for instance, horses as well, unless they made sudden lucky movements or received indications from outside themselves, might easily starve to death in these circumstances which offer hardly any difficulty to human beings—or to chimpanzees.

The achievement of the anthropoids, however, deserves more careful consideration. To this end, the circumstances were intentionally somewhat confused: (11.6.1914). The objective, tied to a string, lies on the ground on the further side of the bars, and three more strings, besides the "right" one, run from the approximate direction of the objective, crossing the "right" string and each other. Their ends lie near the bars (cf. Fig. 7*a*). An adult human being, with only a slight degree of attention, can perceive at once which string is the right one. Sultan is led to the bars, glances out, and then pulls in rapid succession, two of the wrong strings,

and then the right one (the order is indicated by the numerals in Fig. 7*a*).

The field is clearer if only two strings, one right and one wrong, run towards the objective, without necessarily crossing. The appended sketch 7 shows the result in four instances *b* to *e*. (14.6). The distance between the ape and the objective amounts to about one metre and the "wrong" string has one end placed about five centimetres from the objective. These experiments do not permit us to form any conclusion as to Sultan's ability to recognize the "right" string after careful observation, for Sultan never gives himself time to make the effort such attention requires, but simply grips something and pulls—and only twice at once hits on the right string. His mistakes can scarcely be fortuitous; in the course of *five* experiments, he gave the first pull four times to the string which appeared to reach the objective by the shortest distance from the bars.

[There is possibly also a tendency to give the preference to strings lying to the *right*; this would be susceptible to a simple *motor* explanation; for Sultan always takes up his position directly opposite to the objective, and, on all occasions which require the slightest degree of skill, uses his *right* hand.]

When only one string lies with its further end in the neighbourhood of, but unattached to, the objective, everything depends on *how* near it lies. In one of this set of experiments the objective was three metres from the bars, and the end of the string fifteen centimetres from the objective. Sultan glanced cursorily at the end of the string near the objective, but did not move; a few seconds later he began to pull the string, without, however, in the least noticing the objective; all his attention was on the string, and he began to play with it; yet he was in the best of appetites, as the offer of food showed. But when the objective was placed at one

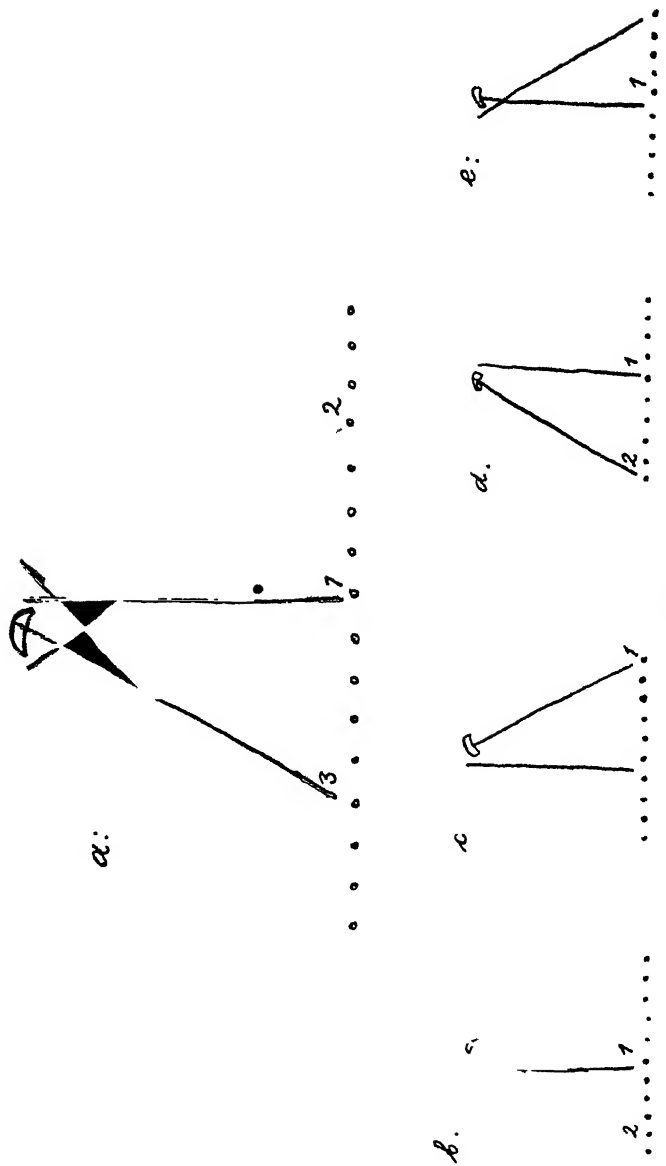

FIG. 7

metre's distance from the bars, and only two centimetres from the end of the string, he pulled hesitatingly, but with eyes and attention fixed on the objective.

A large number of such experiments tend to make the chimpanzee suspicious. On the whole, however, the results justify the following conclusions :

When the end of the string or rope is only at a very small distance from the objective (but much depends on the clearness of the background) the chimpanzee generally pulls the string, after a cursory glance at it.

He will always pull the string if it visibly touches the objective. It appears doubtful whether the conception of "connexion" in our practical human sense signifies more for the chimpanzee than visual contact in a higher or lower degree.

When rope-end and objective are wide apart, the chimpanzee will generally not pull the rope, unless he is interested in it *per se*, or wants to have it to use in another way.

When the distance between objective and rope-end is moderately wide—that is to say, from some centimetres upwards—so that the rope-end lies in a sort of "halo" round the objective even to human perception, the result will entirely depend on the degree of hunger felt by the animal, and the amount of his attention. When very hungry the chimpanzee will pull the rope, while looking at the objective, even when he *must and obviously does see* that there is no contact between them. He then does just the same thing as the proverbial drowning man, who clutches at a straw. The movements of the animal in such cases, to which we shall frequently refer, are slow and give an effect of complete lack of courage.[1]

[1] Hobhouse, *Mind in Evolution* (London 1901, p 155 seqq), has made experiments with ropes on various species of animals; other scientists have done the same We may refer generally to Hobhouse's work, for other experiments described in the following.

(2)

In the experiments about to be described, the objective is not in any way connected with the animals' room. The only possible implement is a stick, by means of which the objective can be pulled towards the ape.

At the beginning of my work at the station, we had seven chimpanzees. Of these, I found Sultan already quite expert in the use of sticks, and Rana had also been observed performing similar feats. The achievements of some of the other chimpanzees will be recorded later; here we have to do with the three cases of Tschego, Nueva, and Koko.

The full-grown female (Tschego), of whose earlier career in the Cameroons we, of course, know nothing, had been kept almost entirely apart from the other animals up to the time of these experiments (26.2.1914), i.e. one year and six months. She had been in quarters that contained no movable objects, except straw and her blanket, but she was freely permitted to observe the pranks of the young apes. She is let out of her sleeping-place into the barred cage in which she spends her waking hours; outside the cage and beyond the reach of her exceptionally long arms, lies the objective; within the cage, somewhat to one side, but near the bars, are several sticks.

Tschego first tries to reach the fruit with her hand; of course, in vain. She then moves back and lies down; then she makes another attempt, only to give it up again. This goes on for more than half-an-hour. Finally she lies down for good, and takes no further interest in the objective. The sticks might be non-existent as far as she is concerned, although they can hardly escape her attention as they are in her immediate neighbourhood. But now the younger animals, who are disporting themselves outside in the stockade, begin to take notice, and approach the objective gradually. Sud-

denly Tschego leaps to her feet, seizes a stick, and quite adroitly, pulls the bananas till they are within reach. In this manœuvre, she immediately places the stick on the *farther* side of the bananas. She uses first the left arm, then the right, and frequently changes from one to the other. She does not always hold the stick as a human being would, but sometimes clutches it as she does her food, between the third and fourth fingers, while the thumb is pressed against it, from the other side.

Nueva was tested three days after her arrival (11th March, 1914). She had not yet made the acquaintance of the other animals but remained isolated in a cage. A little stick is introduced into her cage; she scrapes the ground with it, pushes the banana skins together into a heap, and then carelessly drops the stick at a distance of about three-quarters of a metre from the bars. Ten minutes later, fruit is placed outside the cage beyond her reach. She grasps at it, vainly of course, and then begins the characteristic complaint of the chimpanzee: she thrusts both lips—especially the lower—forward, for a couple of inches, gazes imploringly at the observer, utters whimpering sounds,[1] and finally flings herself on to the ground on her back—a gesture most eloquent of despair, which may be observed on other occasions as well. Thus, between lamentations and entreaties, some time passes, until—about seven minutes after the fruit has been exhibited to her—she suddenly casts a look at the stick, ceases her moaning, seizes the stick, stretches it out of the cage, and succeeds, though somewhat clumsily, in drawing the bananas within arm's length. Moreover, Nueva at once puts the end of her stick behind and beyond the objective, holding it in this test, as in later experiments, in her left hand by preference. The test is repeated after an hour's interval; on this second occasion, the animal has recourse to the stick

[1] As is well known the chimpanzee never sheds tears

much sooner, and uses it with more skill; and, at a third repetition, the stick is used immediately, as on all subsequent occasions. Nueva's skill in using it was fully developed after very few repetitions.

On the second day after his arrival (10.7.1914), Koko was, as usual, fastened to a tree with a collar and chain. A thin stick was secretly pushed within his reach; he did not notice it at first, then he gnawed at it for a minute. When an hour had elapsed, a banana was laid upon the ground, outside the circle of which his chain formed a radius, and beyond his reach. After some useless attempts to grasp it with his hand, Koko suddenly seized the stick, which lay about one metre behind him, gazed at his objective, then again let fall the stick. He then made vigorous efforts to grasp the objective with his foot, which could reach farther than his hand, owing to the chain being attached to his neck, and then gave up this method of approach. Then he suddenly took the stick again, and drew the objective towards himself, though very clumsily.

On repeating this experiment I was even more struck by the clumsiness of this animal; he often pushed the banana from the wrong (hither) side, so that it was once sent to quite a distance from him. In this case—and frequently on other occasions—Koko used his foot to grasp the stick, and continued to make vain efforts in this manner. Finding it of no avail, he suddenly took up a green stalk, with which he had been playing before the experiment began, but this was quite useless, the stalk being even shorter than the stick. From the beginning, Koko held the stick in his right hand, and only had recourse to the left for a few minutes when his feeble muscles were obviously tired; but when using his left hand, the stick wobbled aimlessly from the beginning (it could not have been from exhaustion), and was immediately transferred to the right.

It may be accepted as a general axiom that a chimpanzee who has once begun to use a stick for these purposes is not quite helpless if there is no stick to hand, or if he does not perceive one that is available.

Two days later, after she had played with it a good deal, Nueva, for the following test, was deprived of her stick (13.3). When the objective was put down outside the cage, she at once tried to pull it towards her with rags lying in her cage, with straws, and finally with her tin drinking-bowl which stood in front of the bars, or to beat it towards her—using the rags—and sometimes successfully.

On the day after Tschego's first test, two sticks lay inside the cage, about one and a half metres from the bars. When Tschego was let into her cage, she at first stretched her arm out through the grating towards the fruit; then, as the youngsters approached the coveted prize, Tschego caught up some lengths of straw, and angled fruitlessly with them. Only after a considerable time, as the young apes approached dangerously near to the objective, Tschego had recourse to the sticks, and succeeded in securing it with one of them.

In the next test, which took place several hours later on the same day, the sticks were removed to a greater distance from the bars (and, therefore, from the objective beyond them) and placed against the opposite wall of the cage, four metres from the grating. They were not used. After useless efforts to reach the bananas with her arm, Tschego jumped up, went quickly into her sleeping-den, which opens into the cage, and returned at once with her blanket. She pushed the blanket between the bars, flapped at the fruit with it, and thus beat it towards her. When one of the bananas rolled on to the tip of the blanket, her procedure was instantly altered, and the blanket with the banana was drawn very gently towards the bars. But the blanket is, at best, a troublesome implement, the next banana

could not be caught like the first. Tschego looked blank, glanced towards the sticks, but showed not the least interest in them. Another stick was now thrust through the bars, diagonally opposite to the objective; Tschego took, and used, it at once.

Koko, who had already tried to use a plant-stalk in the same circumstances, three days later (13.7) in the course of the test, ignored the stick which lay a little to one side and on the periphery of his "sphere of action." Only after some time did he grasp the stick with his foot, and thus drew the bananas, clumsily enough, towards him. On a repetition of the experiment, he fetched his blanket and dragged it close to the objective, then let it fall after a short hesitation, and took up the stick once more. A day later, when no stick was available, he repeated the blanket procedure exactly, and then tried to angle the objective with a stone. Some days after he employed a large piece of stiff cardboard, a rose-branch, the brim of an old straw hat, and a piece of wire. All objects, especially of a long or oval shape, such as appear to be movable, become "sticks" in the purely functional sense of "grasping-tool" in these circumstances and tend in Koko's hands to wander to the critical spot.

[Incidentally, an observation on myself: Even before the chimpanzee has happened on the use of sticks, etc., one expects him to do so. When he is occupied energetically, but, so far, without success, in overcoming the critical distance, anxiety causes one's view of the field of action to suffer a phenomenological change. Long-shaped and moveable objects are no longer beheld with strict and static impartiality, but always with a "vector" or a "drive" towards the critical point.]

As is to be expected, variations in the nature or position of the objective have very little influence on the use of the

stick, when that instrument has once been mastered. One hot day Koko even tried to pull a pail of water, which had been left standing in his neighbourhood, towards him by a stick held in each hand; of course, without succeeding. When the bananas are hung out of reach on the smooth wall of the house, he takes a green plant-stalk, then a stone, a stick, a straw, his drinking-bowl, and finally a stolen shoe, and stretches up towards the fruit; if he has nothing else to hand, he takes a loop of the rope to which he is attached, and flaps it at the bananas.

When animals who have developed behaviour to cope with the requirements of a special given situation use the same methods in situations, only similar or partially similar, their observers conclude, often correctly no doubt, that the cloudy perception of the animal sees no difference between the two situations, and, therefore, adopts the same procedure in each. It would be a mistake to give such an explanation when the chimpanzee replaces his stick by other objects. The vision of the chimpanzee is far too highly developed —as can easily be proved both by tests and by general observation—for him to "confuse" a handful of straw, the brim of a hat, a stone, or a shoe, with the already familiar stick. But if we assert that the stick has now acquired a certain *functional or instrumental value* in relation to the field of action under certain conditions, and that this value is extended to all other objects that resemble the stick, however remotely, in *outline* and *consistency*—whatever their other qualities may be—then we have formed the only assumption that will account for the observed and recorded behaviour of these animals. Hats and shoes are certainly not visually identical with the stick and, therefore, interchangeable in the course of the test experiments; *only in certain circum-*

stances are they functionally sticks, after the function has once been invested in an object which resembles them in shape and consistency, namely a stick. As has been shown in the account of Koko's behaviour, practically no limitation with regard to type remains in the case of this youngster, and almost every "movable object" becomes, in certain circumstances, a "stick."

A far more important factor than the external resemblances or differences between stick, hat brim, and shoe, is in the case of Tschego and Koko the *location of the implement* both in relation to the animals themselves and the objective. (Nueva was not tested in this manner, for some reason.) Even sticks that have already been used often both by Tschego and Koko seem to lose all their functional or instrumental value, if they are at some distance from the critical point. More precisely: if the experimenter takes care that the stick is not visible to the animal when gazing directly at the objective —and that, vice versa, a direct look at the stick excludes the whole region of the objective from the field of vision —then, generally speaking, recourse to this instrument is either prevented or, at least, greatly retarded, even when it has already been frequently used. I have used every means at my disposal to attract Tschego's attention to the sticks in the background of her cage (see above) and she did look straight at them; but, in doing so, she turned her back on the objective, and so the sticks remained meaningless to her. Even when we had induced her, in the course of one morning's test, to seize and use one of the sticks, she was again quite at a loss in the afternoon, although the sticks had not been removed from their former position, and she stepped on them in the course of her movements to and fro, and repeatedly looked straight at them. At the same time, *sticks*—and other substitutes—*which she beheld in the direction of her objective, were made use of without*

any hesitation, and she devoured what food she could reach with relish.[1]

We subjected Koko to a similar test with similar results. He made useless efforts to reach the objective: a stick was quietly placed behind him; but though, on turning round, he looked straight at the stick and walked across it, he did not behold in it a possible implement. If the stick was silently moved towards him, so that the slightest movement of head or eyes would lead from the region of the objective to the stick—suddenly he would fix his gaze on it, and use it.[2]

The important factor here is not only the distance of the stick from its objective; for instance, suppose that Koko is seated in the centre of his chain-circle, the objective set down outside the circumference, and midway between ape and objective is placed a stick: Koko will then generally pick up the stick on the way to the objective, and naturally so; for his glance towards the goal can hardly miss the stick in this case, and it is highly probable that he *sees them "in connection,"* which would be favourable to the result.

There is no absolute rule here, however. It sometimes happens that some useful object, at quite a distance behind, is noticed as the animal looks back, and fetched. Such a result is only to be expected in the variety of circumstances that are at work; but as a rule, and to a conspicuous degree, the behaviour was as described in the preceding pages.

[1] The blanket (see above) lay in the animals' sleeping den, as far behind as the sticks, and nevertheless was fetched: yes, but the open door of the den is close to the bars, in the foreground of the cage, so that Tschego, with a slight movement of the head, which permits the bars and the objective to remain in her field of vision, can also see the blanket Whereas, if she faces the sticks, the whole region of the objective vanishes. Besides, the blanket is seen and used daily, and is thus *sui generis* and in a different category to other objects.

[2] The animal must not see the stick in motion, i e when it is being pushed towards him, that would bring quite new conditions into play I removed Koko or held my hand over his eyes, when I moved the stick; in the first case I replaced him before the objective in his exact former position Such young animals can be handled easily, and Koko was quite used to it.

We found, however, that, although to some degree the use of the stick as an implement depends on the geometrical configuration, this is only so on first acquaintance. Later on, after the animal has experienced frequently the same conditions, it will not be easy to hinder the solution by a wide optical distance between objective and implement. But one can oneself "feel" that at the *inception* of these tests there is a dependence (on spatial position) such as has been described above. If one asks where to place the stick, the conviction arises—at once and without any previous reasoning—that the solution will be specially easy, if the stick is in the immediate neighbourhood of the objective, and can be visualized in connexion with the objective. However familiar the procedure in this situation may have become to us, we still dimly apprehend the decisive factors.

(3)

When the objective is fastened *at a height* from the ground, and unobtainable by any circuitous routes, the distance can be cancelled by means of a raised platform or box or steps which can be mounted by the animals. All sticks should be removed before this test is undertaken, if their use is already familiar—the possibility of utilizing old methods generally inhibits the development of new ones. (24-I-1914). The six young animals of the station colony were enclosed in a room with perfectly smooth walls, whose roof—about two metres in height—they could not reach. A wooden box (dimensions fifty centimetres by forty by thirty), open on one side, was standing about in the middle of the room, the one open side vertical, and in plain sight. The objective was nailed to the roof in a corner, about two and a half metres distant from the box. All six apes vainly endeavoured to reach the fruit by leaping up from the ground. Sultan

soon relinquished this attempt, paced restlessly up and down, suddenly stood still in front of the box, seized it, tipped it hastily straight towards the objective, but began to climb upon it at a (horizontal) distance of half a metre, and springing upwards with all his force, tore down the banana. About five minutes had elapsed since the fastening of the fruit; from the momentary pause before the box to the first bite into the banana, only a few seconds elapsed, a perfectly continuous action after the first hesitation. Up to that instant none of the animals had taken any notice of the box; they were all far too intent on the objective; none of the other five took any part in carrying the box; Sultan performed this feat single-handed in a few seconds. The observer watched this experiment through the grating from the outside of the cage.[1]

There was something clumsy in the animal's execution of this feat. He could quite well have shoved the box right under the bananas; as he trundled it along just before his jump, the open side of the box came uppermost, Sultan did not alter this, but stepped on to the edge of the box, which was, of course, less convenient as a "take-off." Also, he did not place the box lengthways vertically which would have saved waste of energy. But the whole action was too rapid to allow of delay for these refinements.

On the following day the test was repeated, the box being placed as far from the objective as the available space permitted, i.e. at a distance of five metres. As soon as Sultan had grasped the situation, he took the box, pulled it along till it was almost directly beneath the bananas, and jumped. On this occasion a covered side of the box was uppermost.

[1] Except in a few cases, which will be fully recounted, the observer's rôle is only that of preventing the easiest methods of procedure, detours in the ordinary sense He can be present without damaging the test; the chimpanzees take little notice of him. It is, of course, understood that he is absolutely neutral and passive, except when the contrary is explicitly stated

We shall describe elsewhere the results of this box-test in the cases of Tschego and the other five animals of this group. Nueva unfortunately died before she could be tested. Koko was faced with this problem, and gave most curious results.

On the third day of his residence at the station (11.7), he was given a small wooden box as a toy. (Its dimensions were forty by thirty by thirty centimetres.) He pushed it about and sat on it for a moment. On being left alone, he became very angry, and thrust the box to one side. After an hour had elapsed, Koko was removed to another place. There his chain was fastened to the wall of a house. On one side, one metre from the ground, the objective was suspended from the wall. The box had been placed between three and four metres from the objective, and two metres from the wall, while Koko was being conducted to his new place. The length of his rope allowed him to move freely about the box and beside the wall where the objective hung. The observer withdrew to a considerable distance (more than six metres from the box, and the same side), and only approached once in order to make the objective more attractive. Koko took no notice of him throughout the course of the test. He first jumped straight upwards several times toward the objective, then took his rope in his hand, and tried to lasso the prize with a loop of it, could not reach so far, and then turned away from the wall, after a variety of such attempts, but without noticing the box. He appeared to have given up his efforts, but always returned to them from time to time. After some time, on turning away from the wall, his eye fell on the box: he approached it, *looked straight towards the objective,* and gave the box a slight push, which did not, however, move it; his movements had grown much slower; he left the box, took a few paces away from it, but at once returned, and pushed it again and *again with his*

eyes on the objective, but quite gently, and not as though he really intended to alter its position. He turned away again, turned back at once, and gave the box a third tentative shove, after which he again moved slowly about. The box had now been moved ten centimetres in the direction of the fruit. The objective was rendered more tempting by the addition of a piece of orange (the *non plus ultra* of delight !) and in a few seconds Koko was once more at the box, seized it, dragged it in one movement up to a point almost directly beneath the objective (that is, he moved it a distance of at lease three metres), mounted it, and tore down the fruit. A bare quarter of an hour had elapsed since the beginning of the test. Of course, the observer had not interfered with either the ape or the box, when he "improved" the bait. The enhancement of the prize by the addition of further items is a method which can be employed over and over again with success when the animal is obviously quite near to a solution, but, in the case of a lengthy experiment, there is the risk that fatigue will intervene and spoil the result. It must not be supposed that before the exhibition of the orange, the animal was too lazy to attain its objective ; on the contrary, from the beginning, Koko showed a lively interest in the fruit, but none—at first—in the box, and when he began to move it, he did not appear *apathetic* but *uncertain :* there is only one (colloquial) expression that really fits his behaviour at that juncture : " it's beginning to dawn on him ! "

There are other definite proofs that the animal did not hesitate out of pure laziness to employ a method that he would have understood quite well. For instance : the test was repeated after an interval of a few minutes, the objective this time was fastened to the same wall, but on the other side of the fastening which held Koko's rope to the wall, and more than three metres from its former position ; the box was left untouched, standing just under the former site

of the objective, where Koko had himself dragged it. He sprang at the new objective in the same manner as before, but with somewhat less eagerness; at first he ignored the box. After a time he suddenly approached it, seized and dragged it the greater part of the distance towards the new objective, but at a distance of a quarter of a metre he stopped, gazed at the objective, and stood as if quite puzzled and confused. And now began a tale of woe for both Koko and the box. When he again set himself in motion, it was with every sign of rage, as he knocked the box this way and that, but came no nearer to the objective. After waiting a little the experiment was broken off, so that the box should not be knocked unintentionally in the direction of the fruit, and thus afford a solution by pure chance.

The next day the box was again ignored although Koko was much exercised to reach the objective, and tried the most varied implements, among others the aforementioned old shoe, in lieu of a stick. Occasionally he laid hold of the box, but it was not evident that he had the objective in view as he did so. Two days later the scene was changed, the fruit being fastened to another wall, and the box placed four metres away from it. The animal used every means —except the box—but could not reach the prize. After one of these vain attempts, on turning away, the box caught his eye, and he looked fixedly at it, so that the observer momentarily expected him to fetch it. But Koko looked away again, and then tried a new method which is described below. As that, too, was unsuccessful, he sat down, exhausted, on the box and presently began to hop about playfully, still seated on the box. In the course of the next test, two days later (16.7), it became increasingly evident that the solution had gone from his recollection. In this experiment, two boxes were placed about five metres from the objective. Koko eyed them suspiciously from time to time, but did

not fetch them, keeping to other methods of procedure. Finally, covering Koko's eyes with our hands, we placed one of the boxes so close to the wall that—as he forthwith demonstrated—he had only to stand on it to touch the wall immediately under the objective with his hand. Therefore, if the box were pushed a very little further, the thing was done. Koko stretched and strained himself as he stood on the box, but he did not give the slight propulsion that was alone necessary. The next day he was allowed to play with the box for a short time; among his movements we noticed the following: throwing over the box, hopping on it, and sitting in it. Five days later (21 7), on the occasion of the next experiment, Koko used anything and everything he could lay hand on as a substitute for the familiar stick; and the box he merely stared at frequently in a peculiar manner. Suddenly he flew at it and began a violent attack: he was beside himself with rage, flung the box to and fro, and kicked it. These outbreaks which had been rarer on previous days and were considered the result of accumulated ill-humour, were now concentrated entirely on the box. Again and again as he turned from the objective, his eyes sought the box; he glared, and then fell upon it.

After an interval of nine days, the experiment was continued (30.7). In the intervening period Koko was not shown the box at all. The objective was hung on the wall as before, and the box placed two metres away from it (diagonally). Koko stretched towards the prize for a while in vain; he turned away, saw the box, and stared at it for a moment. He went up to it and seized it; for a minute it looked as though he was about to attack it again; but instead, he dragged it hurriedly beneath the objective, mounted it and pulled down the fruit. The place in which this test was completed was not the scene of the first experiment, and between the two dates there was an interval of nineteen

days, during the first half of which no trace of a solution appeared, except an equivalent of the words: "there's something about that box."

After this Koko did not lose mastery of the solution, although in the two repetitions of the test which immediately followed his success, he at first stretched up and leapt towards the fruit; but the box was presently brought up after all. In the second repetition Koko had set down the box too far from the objective in his haste, so could not reach the prize when standing on it. He got down at once and pushed the implement into the right position. The initial distance between objective and box did not seem to exert any influence, the box being carried for six metres as quickly as for two. The following day Koko began to turn towards the box and seize it as soon as anyone came in sight carrying edibles. He often picked up a stick, too, and carried it with him; he either threw the stick away as he mounted the box, or on other occasions hooked the fruit off the nail with it. Such a mixture of methods was observed in other chimpanzees also: sometimes they were ingenious and, in fact, the only practicable means to the desired end.

[I have thought proper to give this account in minute detail, as the behaviour of the animal showed such variations—perhaps on account of his extreme youth—and from a theoretical point of view was so much more suggestive than if every test had gone off smoothly. One can only try to explain these achievements by observing them in detail. It is also, in my opinion, quite as needful to the understanding of the chimpanzee to discover what behaviour led him to his solutions, as to know that he "uses a box as a tool" at all.]

Variations of the Test.

The day after Sultan had used the box for the second time, the objective was fastened to the roof of another room

which was at a much greater height from the ground. Two boxes stood close together on the ground, about five metres from the fruit. Sultan was alone. At first he took no notice of the boxes, but tried to knock down the objective, first with a short stick and then with one of more appropriate length. The heavy sticks wobbled helplessly in his grasp he became angry, kicked and drummed against the wall and hurled the sticks from him. Then he sat down on a table, in the neighbourhood of the boxes, with an air of fatigue; when he had recovered a little, he gazed about him and scratched his head. He caught sight of the boxes—stared at them, and in the same instant was off the table, and had seized the nearer one of them, which he dragged under the objective and climbed upon, having first re-captured his stick, with which he easily secured the prize. The box was not placed vertically, and Sultan was too inexpert at jumping to be able to dispense with his stick.

The next day we removed the sticks, but placed boxes and objective as before. A light table, which was not used in the former test, stood in the same place, about three metres from the objective. Sultan made many fruitless attempts He pulled one of the boxes beneath the prize, but after obviously measuring[1] the distance with his eyes, he did *not* mount the box, which would have been useless in any case, but pushed it hesitatingly to and fro beneath the fruit. One corner of the box happened to land on a thick beam which lay on the ground a little to one side. Sultan gazed upwards, but the distance was too great even then, and he fell upon the box in a fit of anger. Presently he took notice of the second

[1] The term " measuring " is no " anthropomorphism ". At any time it may be observed that a chimpanzee, before making a wide jump at a considerable height, looks carefully to and fro across the intervening space As an arboreal animal with immense range of spring and the need to use it, he *must* be able to measure distances It would be quite unjustifiable to object to the use of the term " measuring " in this connexion

box and fetched it, but, instead of placing it on top of the first, as might seem obvious, began to gesticulate with it in a strange, confused, and apparently quite inexplicable manner; he put it beside the first, then in the air diagonally above, and so forth. This state of unordered confusion was followed by the customary paroxysm of anger; he seized the intractable box and rushed up and down the room, bumping the box behind him and dashing it with his whole strength against the wall. When his rage had spent itself, he gave a calm, quiet look at the scene before him and made a long step in advance by *lifting* the first box, which was still directly beneath the objective, and placing it upright on end with a powerful and dexterous movement. Unfortunately a second look showed him only too clearly that even thus he could not reach the objective, and he did not mount the box. He turned instead towards the beam against which the box had been wedged and, by dint of his utmost exertions, lifted it at the end nearest to the objective. but could not raise it high enough for his purpose. After his second disappointment, he again gazed round helplessly and finally noticed the table.[1] He seized it by one leg and dragged it towards his goal, but turned it over through his hasty, jerky movements. Had he brought it under the objective, his problem would have been solved. As the only resemblance between table and box is that both are made of unpainted wood, this must be either an example of the discovery of a new method, or a substitution to which our remarks on the case of stick-substitutes are entirely applicable. It is absolutely impossible that Sultan should simply "confuse" box and table.

Immediately after the test described above, the following experiment was undertaken: the table was removed and a small ladder of five rungs, one metre thirty centimetres

[1] This was not the same table on which he had sat down to rest himself the previous day, and which apparently was too heavy and firmly fixed into its corner to become a tool

in length, was put down, not in the same place, but at about the same distance[1] from the objective, which was hanging from the roof near a wall. After a few seconds, Sultan took up the ladder, pulled it underneath the objective and tried hard to lift it into position. As the result of a most peculiar proceeding which is described below, he only succeeded in mounting the ladder and securing the prize after a considerable interval.

When the other apes had familiarized themselves with the use of the box, their behaviour showed no appreciable difference from Sultan's. Therefore it is quite permissible in everything that follows to use also the observations made on them; they were strongly aided by others at the first use of the procedure, but they varied the method quite independently later on, and in quite a similar manner as Sultan.

We have watched all of them gradually replacing box, ladder and table, by a highly miscellaneous collection of objects; stones, iron grills from the windows of the cages, tins, blocks of wood, coils of wire, all these were indiscriminately collected and employed as ladders or footstools—objects which in the practice of chimpanzees are almost identical functionally. But the most curious variation is that recounted below, adopted by Sultan immediately after his first attempt with the ladder, when he could not stand it in position. In order to urge the now fatigued chimpanzee towards fresh efforts, the observer emerged from his usual place in the background, and approached within an arm's length of the objective, to which he pointed. Suddenly Sultan jumped up, seized the observer's hand, and tried with all his strength to drag him towards the fruit. As I received the impression that Sultan wanted to make me *give* him the fruit, I shook him off, and then, as he continued with the greatest persistence to seize and drag at my hands and

[1] The distance was about three metres

feet, I pushed him abruptly away. He fell into a paroxysm of fury, with the accompanying symptoms of throat convulsions and erection. Presently the keeper passed by crossing the room beneath the objective; Sultan walked quickly up to him, took his hand, pulled him in the direction of the fruit, which was behind him, and made unmistakable efforts to climb onto his shoulder. The keeper freed himself and moved as far away as the space allowed, but Sultan would not let him be and pulled him back again till he was underneath the goal. At my instructions the keeper made only a pretended resistance, and it only took a few seconds before Sultan had sprung on his shoulder, and torn down his prize. The animal was now absolutely "set on" this easy method of solution, but before he was, in the interest of the experiments, taught to relinquish it, there took place several violent scenes, during which Sultan more than once appeared on the point of suffocation.

A further modification of this method, namely, the employment of another chimpanzee as a footstool, was spontaneously introduced by little Konsul, who, *nota bene*, like the other apes, had not seen Sultan using us as ladders. The circumstances were particularly happy: Konsul was in the habit of walking directly behind one of the other animals and, so to speak, "in his footsteps", placing both hands on his elder's shoulders and keeping step with him. As a rule, the larger animal made no objection; on the contrary, one of the others would often place Konsul's hands on his own shoulders, as an invitation so to accompany him.[1] In the course of one of the

[1] Tschego showed for months a strong friendship for the little creature When she emerged from her den and joined the others, Konsul attached himself to her in the manner described above, or (later on) sprang on to her shoulders and let her carry him like a horse I do not know whether the ape-mothers sometimes carry their children thus In this case the "keeping step" of Konsul's would be a kind of "survival" (*Suckling* infants they carry in front of the lower abdomen, see von Allesch, *Berichte der Preuss Akad d Wissenschaften*, 1921) The only other animal I observed "keeping step" was Chica—and she did so rarely

tests, in which the objective was hung from the roof, Konsul was thus walking up and down, supporting himself on Grande's shoulders, when, during their walk, they once approached close to the objective; Konsul made a hasty effort to climb onto Grande's back, and succeeded in doing so but only after Grande, who had no idea of what was intended, had passed the point of vantage. As the pair passed again beneath the fruit, the same incident was repeated and the result was, that *Sultan* now successively clutched observer, keeper and then (when we pushed him away) first Tercera and then Rana and tried to drag them under the objective. Both Rana and Tercera fled before him in dismay; they could not understand why he pursued them with outstretched hand, and feared an attack. Finally he succeeded in pinning down Rana and springing onto her shoulder; but as she crouched close to the ground in terror, he had to make several jumps before he succeeded in grasping the prize, and each time he fell back heavily on the prostrate Rana. From this time onward similar occurrences were frequent; for instance, on the following day, Konsul tried to climb onto Grande, Sultan successively got on to Rana, Grande, and Tercera, and finally Rana on to all the rest together, for there was now a struggling group of chimpanzees, who all gripped each other, and lifted their feet to climb, but none of whom wanted to be footstool. In the course of the same experiment I hung up the fruit in the presence of the animals; as I stepped back, I was seized from behind and held fast; it was Grande, who climbed quickly on to my shoulder and reached the prize. I put up a new goal and retreated as rapidly as possible, but Grande quickly followed me with outstretched hand and lips distended, uttering whimpering sounds, and dragged me into position. The animal was already well acquainted with the use of boxes and was, therefore, perhaps, especially quick to grasp the similar functional value of a human body.

In the same manner as Grande and Sultan, Chica and Rana later on used me, the keeper, or anyone else they could get hold of, as a footstool.

The technique of the use of boxes was forthwith applied to somewhat different siuations. Sultan, for instance, was pursuing one of the others, who was fleeing along the wire-roofing; he was not a sufficiently expert climber to pursue his fellow along the roof, but seized a box, put it beneath the other ape, and sprang from it. The box was too low so he tried to fetch Grande—and so forth. Later, when they all knew the use of boxes and other implements, they unfortunately became used to dragging their tools under such positions of the roof as were lower than the rest, and thus accessible from a relatively slight height.[1]

The method of climbing upon each other was first an interlude in a test, during which the implement was *not* directly visible, but could only be drawn into the situation in consequence of "remembering." (February 15th.) The room from whose roof the objective was suspended communicated by a door with the corridor which, at a distance of eight metres from the door, turned at a right angle. Round the turn of the corridor stood the ladder, which was therefore completely invisible from the room containing the fruit. *Before* the test, the apes were allowed to play freely in the passage, where they could see the ladder but not the room, for the door was still shut. Sultan showed that he, at least, did notice the ladder, for he gnawed persistently at one of the uprights. After the door was once opened, the objective exercised such a powerful attraction that not one of the animals stayed in or returned to the passage. One effort after another (see above) was made to reach the prize, but even Sultan did not remember the ladder. Finally he was

[1] As the wire was thin, it was often possible at this time to observe the chimpanzees in a state of complete freedom.

led by the hand into the corridor and past the ladder, but without having his attention specially called to it. There was no immediate effect; on his return to the room, he tried as before to use the others as footstools. Immediately there was a violent set-to among the animals, so that the observer was forced to intervene and separate them; when peace had been restored, Sultan was missing. A bumping sound proceeded from the corridor, and he reappeared dragging the ladder behind him. As in this instance my observation of the test had been interrupted and the crucial moment had escaped me, I repeated it on the following day, but used a *box*, placing it exactly where the ladder had stood, I took care that Sultan should have seen it before the test began and fastened up the fruit as on the former occasion. Sultan made one effort after the other towards solving his difficulty; e g. he pulled one of the iron bars in Tschego's sleeping-den[1] out of its socket, propped it like a ladder against the wall and swarmed up it towards the fruit. But all his efforts were made in the neighbourhood of the objective; he appeared to have forgotten the box. After waiting a long time, I took Sultan's hand, led him up to the box, past it—without drawing his attention to it—and back; but the only immediate result was that he clutched my hand more tightly as we returned, and tried to pull me under the objective. When this failed, he took the greatest trouble to find something in the immediate vicinity that he could use as a tool, and had recourse to a long bolt which was fastened to the outer side of the door; he hung on to the door, which was half open, and tore at the bolt with all his power. This time the observation succeeded: *quite abruptly, and without visible external cause,* Sultan ceased belabouring door and bolt, *remained for a moment motionless,* sprang to the ground, traversed the

[1] This den was the *first* room opening from the corridor, and just next to the open door.

passage at a gallop, and was back in a moment with the box. In that second, in which his behaviour obviously took a fresh direction, the door covered and concealed the objective from his view, which did not prevent him from trying to tear away the bolt as an implement: yet the box was at a much more considerable distance, round the corridor corner, and behind his back. It is evident, however, how immensely delayed the solution may become when the adequate implement can be introduced only through the action of memory. Sultan had already passed through the same test (with the ladder) the day before; nevertheless, it was possible *during the test*, when there must have been a strong drive towards the objective, to lead him past the familiar implement *without the solution suggesting itself to him*; but of course this excursion of a few seconds' duration certainly brought him out of "the region of the objective". At the end of the passage even the bolt appealed to him as an implement, although the objective was not visible to him simultaneously; but the whole region of the door was in immediate contact with the room in which the experiments took place. The difficulty here therefore seems similar in kind to—though much greater in degree than—those which had faced Tschego and Koko, owing to the unusual positions in which their sticks were placed. The best tool easily loses its situational value if it is not visible simultaneously or quasi-simultaneously[1] with the region of the objective.

In the test now to be described the problem and its solution are externally different from the former examples, but in principle they are similar. The apes had all become expert in the use of boxes by the time this experiment took place.

D1 to D4 represent the four doors of the Ape-house H, opening on to the playground P, the doors are identical in appearance and situated at equal intervals of distance from

[1] This term hardly requires explanation

one another; O is the objective which hangs from the wire roof, but so high that it cannot be reached from the ground. The precise point from which it was suspended was chosen so as to be directly opposite to the hinges of the door D2, at a distance slightly exceeding the width of the door. It was at about the same height from the ground as the lintel of the door. The apes had now got out of the habit of climbing along the wire-roof; they no longer ventured to do so during the tests, at any rate.

(April 12th.) The doors 1, 3 and 4 had been shut; door 2 was not latched, but very careful attention was necessary to perceive that it was "different" from the other three.

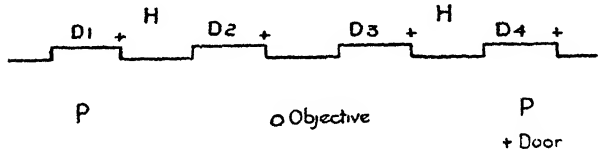

FIG 8.

Sultan was then fetched. On perceiving the objective, he picked up a short stick which he forthwith threw away without attempting to use it—it was much too small. Immediately after, his glance fell on D2, at which he stared fixedly for several seconds, without moving. Finally he went up to it, opened it—still standing on the ground—and climbed upon it. As he had not opened the door at a full right angle to the wall, he could not quite reach the objective by this means. He therefore dismounted, pulled it wide open and then climbed on to it again; he would have reached the objective if his weight had not swung the door somewhat back from the right point. So he stopped, again descended, and, placing the door in the correct position, captured the prize without further trouble. His correction of the procedure in the beginning of this experiment and the "compensation" of the door's swing back, were carried out with a lucidity

which no human being could have surpassed, very much in contrast to his behaviour in certain other situations, as will be recounted later.

As Sultan had succeeded in this experiment so rapidly, it was repeated with Rana, who was unquestionably the least intelligent of our animals (April 14th). She entered the room, beheld the objective, and gazed towards the door. Then she climbed along the beams to the lintel and pushed the door off from the wall, so that she was able to secure the objective, seated on the top of the door and travelling with it.

The door which both animals utilized is that of the room in which Sultan spends his nights. Rana sleeps in the room behind D1. Both have often perched on the doors; at

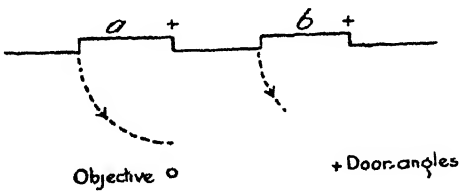

FIG 9.

one time Sultan as he ate his meals used to squat on door D2, which was then thrown quite back and hooked to the wall. Undoubtedly they had both had occasion to propel doors to and fro, when in this position; but what is novel in this situation is the presence of the objective at right angles to the hinges. Their previous acquaintance with the doors, it is true, greatly facilitated their success in this test.

(Test on May 6th.) All four doors were pushed to in the same manner, without being latched. The objective was suspended in front of D3 instead of D2. Rana was tested alone on this occasion, as before. She grasped a stick and climbed up the wall with it in her hand, almost

opposite the objective, lifted the stick once, dropped it, pushed door D3 open, and thus attained the fruit.

In the course of similar variations on this test it may happen that one of the animals does not open the most convenient door, but the one adjacent; e g (cf. Fig. 9) door *b* instead of door *a*. But this action, too, is to some extent directed towards the objective, and the door is actually only opened so far as to be at its nearest to the prize. Possibly the fact that only a slight propulsion of door *b* brings it directly opposite their goal will account for this. We shall see—in the second series of our investigations—that the turning of the doors and the form of space traversed thereby are less comprehensible to the apes than simpler movements and their corresponding forms of space.

[Tschego's behaviour in this experiment was quite clear. This adult ape was, as a rule, too lazy and too heavy to be used in all the tests suitable for the youngsters. Generally she was present during their performance and appeared to take no notice of them. She had seen the manipulations of the door, in the course of the experiment just described squatting apparently passively in Rana's immediate neighbourhood. A new objective was put in position, and all the doors were closed but not latched. After an interval of apparent total indifference, Tschego slowly got on her feet, approached the right door, opened it at right angles so that it pointed straight at the fruit, and laboriously climbed up the *outer* side of the door—that facing the playground. It was the first time she had done so and she was truly no expert at gymnastics! Under its heavy load the door swung slowly back. Tschego at once ceased her scramble up the door, descended, opened the door again at right angles and ascended once more, with the same result. She again returned to the ground, opened the door carefully at right angles and climbed it *edgeways* with infinite trouble; but always the

door received an impetus, though but a feeble one, and began to move slowly away from the desired goal. After having once more corrected the position, Tschego climbed again, with unusual celerity and from the *inner (room) side:* the door remained stationary and she attained the fruit. It is probable, of course, that the behaviour of the young apes of which she had been witness influenced Tschego to some extent; but the triumphant final tactic was entirely her own achievement; only on one previous occasion (Sultan's first test) had the door swung on its hinges away from the objective, and then he did not change the side which he climbed.]

(4)

A gymnastic bar about two and a half metres high had suspended from its projecting end a strong rope, with which the animals often played. The objective had been hung from the roof on a level with the top of the frame, two metres from the rope and about two from the ground.

(February 27th.) Sultan tried to lift or drag along the heavy ladder which had been used to bring the objective into position, and was lying close by; then he turned his attention to a heavy board—also in vain. After having once more turned to the ladder, he climbed the gymnastic bar, and saw from that eminence a broken broom: he descended, picked up the broom, and returned to his point of vantage, where he endeavoured to knock down the fruit with it. He could not succeed, of course; so still armed with the broken broom, he returned to the ground, and tried to use the miserable implement as a "jumping-stick" (cf. below) from beneath the goal, but almost at once ceased the hopeless effort. He pulled about the heavy board and the ladder once more. Then he tried to use the observer as a substitute

for the ladder. On being repulsed, he returned to the gymnastic bar. He seized the rope and swung towards the objective, but with little energy, as if it were a hopeless undertaking; he then climbed upon the upper bar and squatted there, staring fixedly at the fruit, and with an attitude and expression which in a human being anyone would have described as "thoughtful" As his hesitation in handling the rope had suggested that he was afraid to swing as far as was necessary—for Sultan was not only a mediocre gymnast, but also in his childhood quite sufficiently cautious, to say the least—the objective was hung lower and a little nearer to him. A few seconds later Sultan seized the rope, swung himself up with sufficient energy and tore down the fruit. Neither during the first half of the experiment, nor while the place of the objective was being altered, nor afterwards, was his attention drawn by the observer to the rope.[1]

Sultan was removed, the fresh fruit hung up in the *latter* position of the old objective, and Chica, accompanied by Tercera, was let into the room. After the two had recovered from the dread of being alone, they began to take an interest in the objective. After gazing up at it, Chica mounted the bars, pulling the rope with her. She squatted on the frame, swung the rope-end out towards the fruit, as though to knock or lasso it down, but the distance was too great for her. She presently relinquished this method; climbed down part of the way, still holding the rope, swung herself vehemently forward, and captured the prize.

(March 7th.) Grande and Rana, in the same circumstances, simultaneously approached the bars and at once and simultaneously seized the rope and tried to swing themselves towards their goal. But this effort failed—for physical

[1] In future I must excuse myself from further repetition of this statement. *Every* indication and *every* assistance given are expressly mentioned in the accounts of the tests.

reasons—and Rana retreated before the formidable Grande. Grande, however, was even less expert as a gymnast than Sultan: even undisturbed by Rana, she did not achieve more than a short and feeble swing. As she turned away, Rana solved the problem with an impressive sweeping parabola. She was much better in this respect than Grande, who, like Tschego, left Mother Earth seldom and unwillingly.

(5)

An experiment, practically a reversal of the "tool-using," consists in placing a movable object across the path of the objective so that the problem can be solved only by its *removal:* it is impossible to "go round it." In comparison with the cases already described, in which implements have been used, this removal of an obstacle appears to the adult human being extremely simple; one is inclined to say, before the test: "here is something the chimpanzees can do at once." To my astonishment this estimate is not correct.

The obstacle used in all cases was a box: the somewhat heavy transport cage of Konsul, which was a familiar object to all the apes, and had been used as a footstool by Rana, Sultan and Grande,

(March 19th.) The box was placed in the barred room in immediate contact with the bars and standing on the smaller end so that it could easily be knocked over. Outside the bars, and immediately opposite the centre of the box, the bananas lay on the ground; they could be reached at once with a stick, if the box were pushed aside or even knocked over.

Sultan's first actions were not clear: he seated himself on the box and tried vainly to reach the objective with the stick Sometimes he shook the box a little. Finally he lost hold of the stick, which fell outside the bars, and no other

was available. Then Sultan actually took hold of the box at one side and pushed it a little away from the bars, so that he could easily have reached the prize. But he walked off without paying any attention to it. The test was broken off here, as Sultan appeared, from its inception, indifferent and indisposed to take trouble. A little later, after the box had been replaced at the bars, the young animals were all let into the room Only Rana shook the cage a little, but did not move it away, and presently Sultan, obviously excited by the competition, "took a hand," removed the obstacle, and pulled in the objective with the stick. He probably had no special interest in the matter on the first occasion, that is, he was not at all hungry. But it is unlikely that the same "excuse" held good for all the other apes.

(February 20th) The scene was composed in the same manner, except that the objective lay outside the bars just in front of them, so that the use of the stick was not necessary. The smaller animals were led into the room, with the exception of Sultan. They all tried to secure the objective, by mounting the box and reaching from either side of it, and showed plainly the intensity of their interest. As they could not reach it in this manner, they began to climb and sit about with lazy indifference on the box. As even Rana made no effort to push the box away, we may perhaps interpret her shaking of it on the previous occasion, not as an attempted solution, but as the preliminary "first touching" or—and especially in Rana's case—first "smelling out," which is customary in their behaviour towards new and unfamiliar things. If the creatures did not learn more from watching Sultan cope with the problem, that is quite in harmony with the observations we have repeatedly made, to the effect that the chimpanzee has great difficulty in taking over solutions from others at second hand (we shall return to this subject in the second part of this work). Finally, just as we were

about to break off the test, thinking our waiting futile, Chica suddenly struck the right solution. She propped her back against the bars beside the box, thrust sideways at it with all four limbs and, thrusting it back, grasped the fruit. She had to exert her full strength as Tercera had seated herself on the top of the box, and remained enthroned with impassive countenance throughout the proceedings. It is an open question whether she was too stupid to realize Chica's intentions or was the most cunning of them all. Perhaps she was a little of both, in a curious and remarkable mixture, but certainly also what, in humans, is politely termed "mentally indolent." In such situations we always found her "sitting on the box."

If Chica's achievement was performed in imitation of what she had seen Sultan do, then she certainly imitated the *substance* of his actions, not their *form*, for her movements in displacing the box were quite different from his, though both came under the category of "removal of the obstacle."

(February 22nd) Grande, Tercera, Rana, and Konsul were subjected to the same test. Not the faintest trace of a solution was observed. In turn, they all stretched out vainly for the fruit, or sat dejectedly on the cage. Incredible as it seems when we consider their achievements in other directions, none of them grasped this simple solution in spite of the examples they had had. Finally Chica was permitted to join them; she saw the objective, seized the cage forthwith, and flung it over (and completely over) into the middle of the room; as she flung it Rana also took hold of it for an instant, and Chica secured the prize.[1]

[1] Her manner of removing the obstacle was quite different from the first occasion. I wish to stress this point for the enlightenment of students who have not observed chimpanzees carefully. What Chica did in this experiment was to *clear away the cage from before the fruit, not* to make this or that series of movements.

In the next test both Sultan and Chica were not permitted to be present The cage had accidentally been placed in an insecure position and wobbled easily. Rana tipped it over towards the inside (i.e. the room) just as Chica had done previously, partly with her help (see above), and reached the objective. It is very probable that this solution was "borrowed"; it was not purely by chance that Rana touched the cage in the former experiment just as Chica was knocking it over. The insecure position of the cage, which shook at a touch, this time, perhaps, made it easier for her.

[(March 16th.) We observed that Tercera, confronted with the same difficulty, shoved a box out of her way.]

(February 23rd.) The same situation was set up for Tschego, except that we had to take into consideration the much greater reach of her arms. It was the first time that Tschego had carried out any experiment. For a long while her response consisted in useless stretching and groping towards the objective while seated on the cage. Finally, we put down a second objective outside the bars and nearer to them than the first, a trifle to one side, within Tschego's reach, but still strongly obstructed by the box Tschego took hold of objective number two, but did not respond to this assistance. She crouched beside the box, facing the bars. For some time nothing happened. Then, however, some of the smaller apes approached from outside the cage —they were permitted to do so as experimental stimulation —and endeavoured to approach the prize. Each time, though, Tschego repulsed them with threatening gestures, wagging of the head, stamping with her feet, and pawing the air with her great hands: for she regarded the objective as her property though it was beyond her reach; otherwise she would not have menaced the little creatures, with whom

she was generally on the best of terms. The youngsters finally gathered closely round the fruit, but the danger inspired Tschego; she gripped the box, which was like a toy in her arms, jerked it backwards, stepped up to the bars, and took the fruit. In this case to know the *time* is of importance; Tschego began to make efforts towards the fruit at 11 A.M., and succeeded at 1 P.M. If the little ones had not intervened, the test would have taken much longer.[1] And this was the case with the solution of a problem which to us appears so elementary, hardly more complex than the pulling of the objective by a rope already attached to it, which the ape does without hesitation. Another thing is to be noted in this procedure. The "obstacle" test was *not* solved either in the case of Tschego or the young apes by a series of imperceptible pushes involuntarily given to the cage in the act of stretching towards the prize. Quite the contrary: *during the lapse of two hours, Tschego did not move the cage one millimetre from its original position,* and when the solution arrived, the cage was not *shouldered* to one side, but *suddenly gripped with both hands,* and thrust back. It was a *genuine* solution.

The next day we repeated the test. The cage was placed exactly as before. Tschego perceived the objective, seated herself beside the cage in her former position, made one ineffectual effort to grasp the fruit, then seized the cage tipped it over backwards into the room, and took the fruit. Time: instead of the former two hours—barely one minute; and the incitement of competition with the youngsters was no longer necessary. The *movement* by which she disposed of the cage *was quite different from that of the day before: she*

[1] This will show that results of value can be obtained only by the exercise of much patience and lapse of time. I have experienced more than once that success was attained in a *happy moment* after *hours* spent in vain.

did not repeat the innervations of yesterday, but *removed the obstructing cage.*

[A full month before this test, Rana showed remarkable behaviour in an experiment which on a cursory examination appears very like that just described. (January 25th.) A large cage, a good deal heavier than the one previously mentioned, was standing on free ground; it was enclosed on one side by bars (and otherwise by wooden walls), so that it was possible to observe that it was resting with the door side on the ground. These cages—several of them—were standing about, and the apes often walked into them if the doorway was clear and not down on the ground. The objective was placed inside the cage, not accessible through the grating, so that the apes stretched their arms in vain between the bars. After some incredibly clumsy attempts to scrape the fruit towards her with a stick, Rana made quite unmistakable efforts to tip over the cage. If she had succeeded, it would have been easy to enter the cage through the doorway and secure the prize. But the weight was too much for her. About five metres away stood a similar sort of cage, with the doorway facing in the direction of Rana's laborious efforts. She suddenly stood still, approached the accessible cage, slowly entered it, turned round, and reappeared with an extraordinary expression of mingled stupidity and reflection; then returned to the first cage and tried once more to overturn it, but in vain. I think it would have been impossible to observe this occurrence without the conviction that her sudden strange excursion into the other cage was the direct result of her efforts to turn the experimental object so that she could enter it. Later, in this account, I shall describe a procedure on Rana's part which somewhat resembles that just described and admits of only one interpretation.

Quite apart from this interlude the fact remains that

Rana had previously tried to overturn a cage in order to reach the doorway. This appears to be the same achievement as above, only, if anything, somewhat more difficult. We must try to see the two experiments in such light that the apparent contradiction vanishes.]

The results of these experiments were later confirmed on all occasions when the crux of a situation was the removal of an obstacle. The chimpanzee has special difficulty in solving such problems; he often draws into a situation the strangest and most distant tools, and adopts the most peculiar methods, rather than remove a simple obstacle which could be displaced with perfect ease.[1]

We must, however, be on our guard against constructing our standard of values for these tests on the basis of human achievements and capacities; we must not simply cancel what appears to us intricate, and leave what appears to us elementary in order to arrive at an ape's capacities (for, to an adult human, for example, the removal of an obstacle appears easier than the use of box or stick as tool, whereas to an ape, both present equal difficulties). We must avoid such judgments because the primitive achievements we are here investigating have become mechanical processes to humans. Thus the comparative difficulty of achievements may have been quite altered, nay, reversed, by the increased *mechanization* of these processes, the degree in which this has taken place being independent of the original difficulty. At the present time it is impossible to decide whether the processes which have become mechanical, and appear to us the easiest, have *originally* evolved most easily and, therefore, earliest. We can only judge what is originally easy, and originally difficult, by means of experimental tests with anthropoids and perhaps other apes, with children and

[1] The task is only facilitated if and when the object in question is moved by accident

primitive peoples (for more advanced problems), and perhaps also with imbeciles and mental defectives [1]

[1] The example quoted on p 39 shows that the results *sometimes* entirely confirm the expectations of adult man But we must keep in mind that experience in the experimental test alone should be allowed to decide