VIII

THE HANDLING OF FORMS

In all intelligence tests which apply to an optically given situation, the subject of the experiment has—if one considers the problem well—among other tasks, to grasp certain forms and *shapes* ("*Gestalten*": v. Ehrenfels, Wertheimer).[1] These factors of form in most of the experiments described have been of the simplest, so that the uninitiated hardly recognize the characteristic properties of "shapes" (*Gestalten*) in them: sheer distances (very often), the relation of sizes to each other (in the experiment with the double stick, the relation of the two openings), crude directions and at the most the components of direction (model experiment of the preceding chapter, experiment with door, etc). But always where a problem of form made greater demands on the animals—i.e. where, untheoretically, one would for the first time speak of forms and shapes (in the narrower sense) —the chimpanzee began to fail, and, regardless of fine details in the structure of the situation, to proceed as if all forms were given him "*en bloc*" only without any more precise structure. This occurred in the experiment with the wound gymnastic rope, with the coiled wire, and in building with boxes. Now, situations in which one tested mammals, from cats upwards, for intelligence, usually contained very complicated forms, especially all sorts of door-bolts and such-like. That animals below anthropoids do not immediately (if

[1] I do not quote v Benussi in this connexion, in spite of his excellent experiments, because I find it difficult to apply his peculiar views on the question of *Gestalt* (theory of production) to the investigation of animals.

ever) understand these arrangements is obvious after what has been said. I cannot make use of such accidentally complicated experimental material when going over to more difficult experiments with the chimpanzee ; and the following tests are directed as much as possible to examining the primary functions of ever-rising degrees of difficulty, which generally remain hidden to the experimenter who makes experiments on " unlocking ", " double-bolts ", and so forth. The points to consider when planning a test are psychological, and not technical, ones ; when an animal cannot undo, or can somehow undo, a complicated fastening, the psychologist still remains entirely in the dark as to what, psychologically speaking, it was or was not able to accomplish.

The following experiences show in what direction one has to proceed so as to discover more complex situations, which will yet be sufficiently clear for the observation and the comprehension of functions :—

(March 2nd, 1914) : Tschego made her first experiments with a stick, pulling fruit with it towards the bars of her den. Now the lower part of the bars are covered with fine-meshed wire-netting, and the animal cannot get hold of the fruit which she has drawn towards her, although it lies so close, either through the tight meshes, or over the netting, which is too high for her arm to reach over it to the ground. About one metre further along, the net is lower : after Tschego has once reached down in vain, she seizes the stick again, pushes the fruit with one clear, continuous movement sideways to where the net is lower (that is, away from where she is sitting), quickly goes to the place, and seizes the fruit without further ado.

Sultan does much the same thing (March 17). The stick is tied to a rope and this is nailed to the frame of the bars. Outside, opposite him, lies the objective, but again the lower parts of the bars are covered with a fine wire-netting; so that

the animal, in spite of reaching over it with his long stick, cannot touch the objective once he has pulled it straight towards him. Sultan takes the stick and pushes the fruit sideways, likewise with a determined movement; he pushes towards a hole under the wire-netting, from where he can touch the ground outside by stretching out his arm. It is very illuminating, especially for the theory of chance, that Sultan, after he has begun to shove the fruit most carefully towards the hole, lets go the stick, goes to the hole, stretches out his arm for the fruit, and, when he still cannot reach it, immediately returns to the stick, and shoves the fruit a little closer to the hole, so that he can get hold of it from the opening.

[If the animal had not been working from that spot at the bars opposite to which the objective lay, but right from the beginning at the spot from which he afterwards reached out his hand, he would have been facing the objective sideways, and would have pulled this to him almost in a straight line, without the indirect procedure described. In order to hinder Sultan from doing this, the stick was so fixed by means of the rope that he could not use it from this second spot (that of the hole) the rope not being long enough. In the actual experiment, both animals work at an angle of 90° to 180° away from themselves, if we take 0° to be the direction objective-animal, in which, in the ordinary way, the stick procedure would have been accomplished. We thus have the case, as before in roundabout-way tests, that an act in itself meaningless, even disadvantageous, becomes intelligent in connexion with another, but only then ("Go later to the second place and reach objective from there"). In fact, the whole taken together constitutes the only possible solution. I have in a former section stated that these circumstances are characteristic of roundabout action, but I did not, at that time, wish to draw any conclusions. After the discussions in the foregoing chapter one question is at least justified.

The first part of the experiment (*a*) (" Pushing away from the animal to another place ") cannot arise intelligently *alone*; for *alone*, it is more disadvantageous than useful; part (*b*), however (" Going to the second place and seizing the objective "), does not yet come into consideration. Is it conceivable that (*a b*) spring from the situation intelligently surveyed by the animal (or man) as one *complete and unitary* plan of action? I see no other way, if the beginning of the procedure, taken separately, contains no trace of a solution, but seems rather to prevent one, and so cannot arise as an isolated part. Actually a whole is required to justify, as it were, its " parts "—for such procedure as described to be intelligently accomplished. The theory of form[1] recognizes wholes which are something more than the " sum of their parts ": here a whole is required, which even stands in a certain opposition to one of its " parts ". That seems peculiar; evidently this state of things would be crucial for any theoretical attempts to understand the occurrence of intelligent solutions physiologically.]

Functionally considered, the behaviour here observed raises two relatively simple points of view. It might be said that the animal knows how to take a roundabout way with an implement, as well as with his own body—though this possibility does not actually occur in its pure state in the test; and, secondly, that the stick is used in reference to a later and totally different action (altering position of the body), which can only take place afterwards, as the finishing off part of the experiment. I will now deal more in detail with the *first* possibility.

It may well seem that this, where the demands on the animals should be ever-increasing, is not the place to discuss

[1] *Gestalttheorie* is usually rendered in this book " theory of shape " (or form), though there is no exact equivalent, and the theory is usually known by its German name [See Tr Preface] (Translator's Note.)

the first point. As the very simplest form of the general type of test, roundabout-way tests can be applied to dogs and, in a limited degree, even to fowls. Many people may think, therefore, that it is not of importance whether a roundabout route is achieved with an implement in the hand, or by the body of the animal; if, in the former case, the animal is familiar with the use of the implement, the making of detours —well-known from its own movements—should almost be self-evident. In fact, this might follow in any intellectualistic conception of the nature of intelligent conduct. But here the same thing happens as otherwise in higher psychology: even intelligent behaviour, the achievement of insight, will not submit to "intellectualistic interpretation." At any rate, the chimpanzee is very far from using the roundabout methods with implements (any objects), as easily as with his own body.

I shall describe tests in this direction which were first performed on the quietest, most carefully proceeding animal, Nueva. She sits behind a railing, outside which, forty-five centimetres away, is a contrivance in the form of a square drawer (open on top), from which one side is missing. The edges are thirty-eight centimetres long, the three vertical sides six centimetres high; this "roundabout-way-board" is placed on otherwise free ground, in such a way that the side *without* a vertical wall is turned away from the animal (hereinafter called the normal position) (cf. Fig. 17). The experimenter places the objective (banana) at point O, and then gives Nueva a rather long stick (March 18th). The animal scratches the objective towards her (0°), but soon cannot get it any farther because the front side of the drawer is in the way. She becomes very distressed, complains, and pleads, but no help is forthcoming. At last she seizes the stick again and tries once more to pull the objective towards her at 0° (i.e. in a straight line). Suddenly she changes her tactics; *instead*

of putting the stick *behind* the objective and pulling, she puts it *in front* and *pushes* it with little jabs, but with all assurance towards the open side (that is, in the direction of about 180°). She keeps up this careful and regular shoving until near the edge of the board, where, without any jerk or unsteadiness in the conduct of the animal, the stick happens to be brought *behind* the objective, which is pulled back several centimetres (about five). The " change " only lasts a few moments and

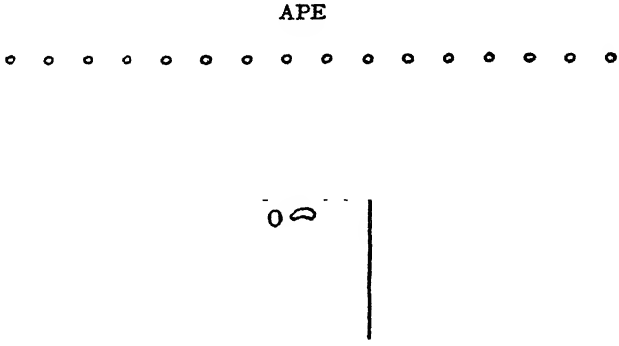

FIG. 17

then she starts pushing quite obviously towards the opening again; the objective is quietly pushed along sideways from the drawer with even movements and finally brought to port in a curve (on the left side from the ape).

On repeating this performance a few minutes later, the whole detour, with a clear beginning at 180°, is again accomplished without any mistake.

At the following day's repetition, Nueva begins by drawing the objective closer at 0°, then, quite suddenly, she changes her direction before the obstructing side is actually reached, thus smoothly pushing the objective over a large portion of the board *away from herself*. She alters the direction for a moment, as on the preceding day, and, after that, carefully and smoothly describes the curve of the detour. (After a few minutes it is again done, easily and without mistake.)

(20.3) The board has an area of fifty centimetres square, and so the circuitous route to be taken is longer. Nueva starts at 0°, and again, before reaching the side, changes suddenly round, and pushes the objective calmly and with care by the circuitous curve to within reach. (Repetition after a few minutes: correct solution.)

[On March 28th, the test is made once more. Nueva begins at 0° and abruptly changes over to 180°. When, in bringing the objective round the corner of the board, its side gets into the way of the stick, the animal quietly, but decidedly, pushes the whole board aside with the stick, and continues her work comfortably.]

Nueva's behaviour in this test is much clearer than anything which will be reported later of the other animals, and yet it shows clearly enough that the only kind of solution which comes into consideration here, and which is actually achieved (after more primitive behaviour at the beginning), can only succeed against some strong resistance. There is no doubt that Nueva's solution is an intelligent one: the new direction (180°) is distinguished clearly from the first one (0°) and there is no scattered trying-around at all. But that it takes such a long time to discover the solution, and that the animal, after the first primitive effort, remains perplexed for a time, that, even after six attempts, the direction (0°) returns first before the movement in the right direction is begun—all this is in sharp contrast to the matter-of-fact way in which chimpanzees *run* or *climb* roundabout ways to their objectives. The curious "change" which is still observed even at the third experiment (on the second day) further shows that it remains hard to accomplish this solution, even after it has once appeared clearly and has been carried out quite a distance. This momentary and spatially very limited backward movement has no element of uncertain trying-around in it. I can best characterize its nature by an approximate analogy:

if a man has to execute movements (which ordinarily he can perform with ease) when observing them in a mirror, it often happens[1] that he is brought suddenly to alter the directions of his movements, as by some force, because the normal adjustment between the visual and motor factors is disturbed. When Nueva reverts, at times, to the normal direction, pulling, the observer gets the impression that the animal itself is only made aware of the change after she has covered a part of the way at (0°). In later experiments, this phenomenon not only occurs again, but is exaggerated to such an extent that it almost becomes paradoxical.

Only one other animal, the clever Sultan, achieved a solution at all, when the board was in its *normal position*. How he managed it is remarkable not only on account of the unpleasant difference as compared with Nueva's experiments (18 3). The board thirty-eight centimetres square is used, and is placed a little farther away from the bars (fifty-five centimetres). Sultan pulls the banana towards him (0°) and endeavours to lift it over the edge ; but, as the side of the drawer makes it altogether unattainable with the tip of the stick, the observer puts it back in its original place. Sultan now moves it sideways (about 90°) to the wall, and when the objective has reached this, begins to lift it with the tip of the stick, and really pushes it out so that it is easy to pull along on the ground. The small vertical detour (six centimetres) over the edge seems to come without difficulty , as soon as the fruit reaches the wall, *lifting movements* plainly take the place of pushing ones.

Up to now, the action has never been directed to the open side. This occurrence is now provoked by an accident which proves in general of strong assistance. A new objective is provided. With the hasty movements which in this experiment distinguish Sultan unfavourably from Nueva,

[1] If I am not mistaken, this experiment was originated by Mach.

and become more and more unordered after many useless efforts, the elastic banana jumps from the board a little way and, in falling down, rolls away in the direction of the open side. Sultan immediately changes his procedure, *pushes* the objective farther *out* obliquely, and then draws it to him in a curve. Exactly the same thing happens at the next repetition; at first the animal works as if quite ignorant, in directions between 0° and 90°, until suddenly, under the strong pressure of the stick the banana bounces away from him towards the open side; again in the same moment Sultan changes his tactics and solves the problem. Of course it had become easier, since the banana thus, accidentally, approached the open edge, and the curve did not need to start from the direction 180°, which in the experiments on the other animals proved to be a particularly difficult one (compare below).

(19.3) In order to make any chance assistance more difficult, the small board is replaced by the bigger one, fifty centimetres square, but the procedure remains the same: Sultan tries to lift the objective sideways over the edge, it bounces away several times, and when it finally rolls close to the open side, he changes over abruptly to the correct movement, and gets the objective into his possession without further trouble. The next time, nevertheless, he again starts by his first method —pushing towards the side; this time the banana does not bounce so near the open side, but back to the middle of the board; this movement seems to act suggestively, for suddenly Sultan works away at 180°, and achieves a perfect solution. The third experiment of the day required no further assistance from chance, the objective is straightway shoved off the board without any mistake, and drawn round in a curve.

After an interval of two months (16.5), the animal first starts off in its original direction (0°); then stopping sharply, the correct solution appears in a faultless curve.

After the final form of the solution, and after the way that the assistance of chance is each time used, I must consider the performance in its final state as intelligent behaviour, even if it is striking that chance assists the animal three times to a perfect solution, and he is yet not able to produce it on its own next time, or even to indicate it. This only seems possible if some strong force is working against the solution, or, to put it more exactly, if such a force is preventing the beginning of the solution (direction 180°) from occurring to him. The second expression is more appropriate, because only the *beginning* in the difficult direction has to be assisted by chance, for Sultan to jump to the *whole* solution. (The last follows directly from the fact that the curve is described as " roundly " as possible, *every time* ; while still on the board the objective near the opening gets that sideways-slanting component of movement which corresponds to the further continuation of the curve on free ground, i.e. the " moving-around.") As to the nature of the accidental aid, several interpretations are possible, the experimental tests of which have still to be made. The solution is brought about either by *the proximity of the objective to the open side*, after it has bounced, or else the deciding factor is the *dynamics* of this jump in the difficult *direction* of the commencement of the curve, or, finally, it is the effect of both together. I consider the last correct ; but according to all other experiences with animals and human beings, the most probable is that *the movement itself with its inherent direction-factor, constitutes the chief suggestive force.*

[It may further be asked how the complete solution-curve can be produced in this manner. To this again, two answers are possible : either one can imagine a connexion by association which, already existing in the animal, by the reproductive force of the chance jumping away, can call into being the whole curve—or there exist, so to speak, " autochthonous "

possibilities in the animal, which effect the sudden appearance of the solution-curve in the new total situation "suggestion of direction in the given structure"; the arising of this solution, in the original static situation, is only prevented by strong opposing forces. This second assumption would in all cases of clear solutions *without assistance* (for example, the conduct of Nueva in a similar test) include the hypothesis that the directions, curves, etc., of these solutions, could arise autonomously (not necessarily "from experience") in the static situation. According to the plan which we have proposed to ourselves in this book, I leave the choice open.]

The numerous tests with other animals need not be reported in such detail, as they only differ from the ones described, inasmuch as the difficulties of the task come out still more definitely. This fact will appear more clearly in a briefer survey:

Chica.

(18.3 and 20.3) Normal position of the board.	The direction 0° is steadily adhered to.
(18.3) The board is turned as shown in Fig. 18.	Chica is so violent, that the objective bounces and jumps towards the opening; immediately thereupon the solution occurs. (At a repetition, the solution occurs only after the same assistance of chance.)
(20.3) Same position.	Direction 0° to begin with; banana jumps away, solution follows. In two repetitions, clear solution from the very beginning. (However, compare below.)

Two months later (16 4) Normal position.	Direction 0°, objective actually lifted over the edge. At repetition, direction 0° is maintained, in spite of strong chance aids ; almost from the open side itself, objective is brought back at 0° But suddenly, sharply distinguished, the solution occurs (180°, and so forth). In two further repetitions the circuitous curve is entered upon correctly from the beginning ; but at the same time there are several " sudden reversals ", such as we are used to in Nueva (by no means mere " trying-around "). Last repetition : even this disturbance disappears.

In the experiments of March 20th, Chica obtains for herself very characteristic aid. She does not, as she used to, work from the ground, but sits down on a cross-beam of the bars about seventy centimetres up, not in the middle of the arrangement, but at point C (cf. Fig. 18). One can see at a glance how the circuitous route is thus facilitated, and not only from a motor standpoint.

Grande.

(18.3 and 14.5) Normal position.	Direction 0° is persisted in, in spite of chance aids. Grande beats the board with rage.
(14.5) Quarter turn to the left.	Grande keeps the primitive direction.

Further quarter turn. (Opening to the side.)	Problem solved at once at 90°.
Quarter turn backwards.	This problem, too, perfectly plainly solved now. (Direction 135°.)
Normal position.	From the beginning 180°, and faultless solution.
One month later (18.6) Normal position.	Clear solution from the very first moment.

. . . . . C . .

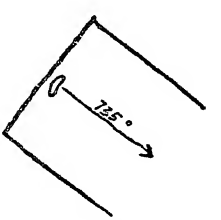

FIG. 18.

[Grande tries at times to shorten the proceedings by drawing the whole board with the stick, or with her free hand, towards the bars. The direction 90° occurs for the first time with this animal when the board is lying at right angles, turned sideways; it occurred immediately under these conditions. That the solution is afterwards quite naturally transferred to the two more difficult positions, although they require modified movements, that this change is taken into consideration, shows the grasping of "structural relation." A further test was added to the one on May 14th (when the board was in its normal position), by giving the board a quarter turn *to the right* from its normal position; the solution came at once, the curvê being made *to the right* corresponding to the change

of position (right and left being here always reckoned from the animal).]

Tercera.

(18.3; 20.3; 18.6) Normal position.	Direction always 0°, although there are chance aids.
(20.3; 18.6) Quarter turn to left.	Clumsy movements at 0°, in spite of chance aids; the animal looks extremely stupid and lazy[1].
(18.6) Further quarter turn to left (opening to the side).	Solution occurs immediately at 90°.
(18.6) Quarter turn back again.	Tercera begins at 0°, discovers the solution immediately by chance aid (beginning at about 135°). In two repetitions the circuitous curve is entered upon from the very beginning.

Tercera, who is usually very lively, but immediately falls into a kind of stupor when she is to perform experiments, shows quite a striking difference between the stick movements *before* the beginning of the solution and *after* the critical moment (e.g. after the aid of chance); at first, she vaguely fumbled, but her movements became precise the moment the direction of the solution appeared. Though her working remains always clumsy.

Tschego.

(20.3) Normal position.	Direction 0° without any deviation.

[1] Contrary to Rana, who tends to be stupid and active.

Quarter turn to the left.	The direction remains for a long time 0°, until Tschego finally in a great rage breaks the stick to pieces on the board.
Further quarter turn to left (opening at side).	Tschego remains at 0° for a while, then suddenly changes over to a clear and careful solution (i.e. beginning with 90°). On repetition the direction is again 0° to begin with, but changes abruptly to the right one.

During Tschego's solutions, a remarkable motor phenomenon takes place; when the objective is already nearly at the opening, the animal changes the stick from its right to its left hand, presumably because the right is tired, and now for a moment performs with its left hand movements in symmetrical relation to the foregoing ones (i.e. to the right at 90°), so that the banana is pushed a few centimetres back into the drawer. This error, it is true, is immediately corrected, but occurs again every time the stick is changed from left to right hand for a moment. This phenomenon has nothing in common with the sudden change from the new direction to the biologically primitive one, noticed in Chica and Nueva, but may be due to the co-ordination of motor functions of both arms, which with us too, will often make *symmetrical* transfers from one side of the body to the other in preference to *identical* ones.

Rana

(19.6 Normal position.	Works all the time at 0°.
Quarter turn to left.	Remains at 0° without any deviation.

Further quarter turn to left (opening sideways).	Rana keeps on for a little time at 0°, but afterwards goes over to the solution. On a first repetition the same procedure takes place, i.e. beginning at 0° and later transition to 90°; on the second repetition Rana keeps obstinately to the primitive direction and does not leave it, even when the objective is quite close to the opening.

These results prove clearly enough that the performance required here is incomparably more difficult than ordinary roundabout ways. If we were to bring any of the chimpanzees into a square room, entirely railed off except for one wall, but in the same proportion of size to the body of the chimpanzee as the roundabout-way board is to the banana, and if the animal were to stand at the spot opposite O (cf. Fig. 4, p. 15), it would perhaps try for a moment to reach between the bars, but would certainly soon start off determinedly on the detour whose beginning is at 180°. The solution would, therefore, come about in a " normal position ", without our being obliged to facilitate the problem for any of the animals (as we have just had to do for the majority) by quarter or half turns of the cage. Even a bright dog, as we have seen (compare above, p. 13), can easily achieve the same in any unknown roundabout situation set up *ad hoc*. The fundamental difference that appears here can, in spite of the simplicity of the experiment, be explained by different factors: first of all, the making of the detours (compare above) may be so much more difficult with a tool than with the animal's own body; but the difference might also have to do with the fact that the *detour must be made, not from the standpoint of the animal towards the objective, but the other way round,*

from the original place of the objective towards the animal In order to decide the theoretically-important question, which factor is the salient one—for both probably act together—detour experiments should be made where the implement (stick) has to be used from the animal *towards an objective.*

The added facility given by turning the board sideways is quite plain; even at 135°, the detour curve is more easily entered upon (Chica), and when the required movement has to start at about 90°, all the animals sooner or later suddenly come upon the solution. We shall have to consider carefully what interpretation to give to this dependence on the "geometry of the situation" (compare also pp. 15 and 36 seqq.). In this matter the detours just described are identical with the ordinary ones made with the body; one has only to test hens instead of chimpanzees for it to be shown that, for them, the detours that begin at 180° away from the objective are altogether impossible as genuine solutions, and that it is more likely that the task will be accomplished on approaching 90°.[1] To the human observer it is obvious from the beginning that the board test must succeed somewhat more easily when beginning at 135°, and much more easily at 90° than at 180°; and, this time, experience supports him. It is not so easy to say wherein the difference lies, perhaps the detour curves will strike him as different in smoothness. But what does this mean psychologically, and in how far does it determine the different degrees of difficulty?

The most striking phenomenon in these tests is still the sudden occurrence of perfectly clear and definite solutions, when once a *single* chance movement has brought the objective a little in the direction of the beginning of the curve; it is as if, at least temporarily and for that experiment, a spell

[1] Even at 90° the obstacle must require a short detour only, if hens shall be able to see the solution-curve.

had been broken. Only the more foolish animals can never be helped even in that way.

[I imagine that no one will wish to play off the frequent occurrence of favourable accidents in these experiments against the considerations of the previous chapter. This is actually the first case in all the observations in which they occur, and it is seen easily enough that the physical movement, which from the standpoint of the animal has to be considered accidental, *must* occur frequently here (whilst in other experiments such one-sided favourable conditions do not exist). The fruit bounces away, in the first place, when the animal is trying to lift it over the edge ; if, during this operation, it falls, as it generally does, from the narrow stick, obviously the direction of the fall is away from the animal, because the stick runs slanting downwards from the animal's hand. Secondly, the fruit bounces away, when the animal, instead of putting the stick on the ground behind the objective, puts it hastily only on top of the fruit, pressing it a little, and then pulls ; the board (in contrast to the ground) is smooth, and if the pressure is at all clumsy or, in excitement, too strong, then the stick will slip off frontwards, and the fruit must bounce away.]

He who reads the description of the experiments attentively, will realize that the performances of the different animals decrease in merit in the order chosen here. (Grande is distinctly better than Tercera, because of the ease with which she produces the solution on turning the board back.) The animals classify themselves in this same order : Nueva, Sultan, Chica, Grande, Tercera, Tschego, Rana, apart from these special experiments too. i.e. if one is determining the degree of their intelligence according to their whole behaviour and the character of their other performances. I only noticed while writing this section, that this board test gives the animals the same places I had already attributed to them long before

in my mind. (Tercera I put between Grande and Tschego with some uncertainty before, as she was so seldom to be induced to serious effort in experiments; but the board test justifies me.)

[Koko is not included in this classification, as the weakness of his arms hindered him very much in directing the stick in the board test, and the uncertain movements were harder to judge. But he undoubtedly first worked at o°, like all the others; with him too the objective once bounced towards the opening, and he then tried, but with no real success, to push it farther in the direction leading to the solution. According to this, he ought to be put equal to Sultan, whose level of intelligence and character he was also nearest to in other ways. Konsul was not tested.]

As far as method is concerned, it follows that in some cases the intelligent treatment of optically given situations can be tested by methods which have a certain resemblance to the working methods of the psychology of perception. (Visual perception of forms in space, of movement, etc.) This work contains only the first beginnings of these experiments, as the animals only gradually drew attention to such possibilities by their behaviour.[1]

[For comparison, I will relate an experiment in which a boy of two years and one month was tested exactly like the chimpanzees. The child may be described as of average intelligence. He is put into a railed-off space, such as is often used for little children. The walls are so low that they reach only to his breast. Inside lies a light stick; outside, out of his reach, the objective. In a little while the stick is picked up as a matter of course, and the objective pulled to him

[1] In future it will be better to use only the vertical sides of the roundabout-way board, and *not its wooden* bottom; perhaps the animals can make the roundabout way more easily on free ground than over *wood and ground;* the sharp contour of the wooden board as against the ground may also make the test more difficult.

with it. The skill with which this is done is distinctly less than that of Sultan, who is twice as old as the child, but greater than that of Rana and Tercera, who are about the same age as Sultan. In whatever way the use of the implement may have developed, it certainly takes place.

On the same day the board experiment is made and in its normal position. The child again immediately takes up the stick, but proceeds so clumsily that he drops it before he has used it. He puts his foot through the bars on to the stick outside and pulls it closer, but does not bring it inside, perhaps because he does not see how a stick lying crosswise can be got through the bars. Instead of that, he hits at the stick with his belt, which has fallen, then stands for a while looking dejected, and makes the onlooker understand that he wants the stick. This is handed to him. The boy takes it, pulls the objective straight towards him with it at 0°, keeps on thus for some time, though the objective bumps repeatedly against the side wall of the board, and finally changes over to the left-hand corner from himself (about 45°)—the observer meanwhile having put the objective in its old place. After many useless efforts, the child gives up the work. He takes the stick and throws it at the objective, then the belt also flies outside ; if he had had anything else to throw it would certainly have gone the same way—just as in the case of the chimpanzee (compare above, p. 88 seqq.). It was proved directly afterwards that the child took circuitous routes himself (i.e. with his own body) without trouble ; a much younger child had, moreover, been tested with success in this respect before (compare above, p. 14).]

The task where the animals have to deviate from the direct path, in dealing with objects, and, instead, to adapt their direction of procedure to the forms before them, can be examined in many experiments differing from each other externally. I will give one more example, in which the

forms which have to be taken into account are somewhat different.

In the introduction an experiment was described in which the animal had only to draw a ring (or a loop) from the stump of a bough (or nail) in order to make the objective fall to the ground, where it could be easily picked up. Actually the ring (or loop) was not noted at all, perhaps because the connexion between the way the ring was fixed and the rest of the situation was not grasped; the animal did not get as far as taking an interest in that. A situation is now prepared in which the animal, as far as one can see, must make an immediate effort in order to find a solution to a connexion of this kind.

On the other side of the bars lies the objective, out of reach. A stout cord is fastened to a stick with which the animal could reach the objective; on the free end of the cord is a metal ring of about six cms. diameter, which is slipped over a nail sticking out vertically about ten centimetres from a heavy case. With the string stretched, the stick does not reach even to the bars, and, therefore, in order to be used, the ring has to be taken off the nail with a movement deviating by 90° from the primitive direction "stick direct towards bars and goal". This movement can be "genuinely" accomplished only if the animals are able to grasp the arrangement "ring over nail". Those who have not seen how chimpanzees deal with more complex forms, may think that there could be no easier task.

(21.2.1914) Sultan pulls at the stick in the direction of the bars (and of the objective), chews and gnaws at the rope where it is tied to the stick, notices the connexion ring-nail only after a considerable time, and then does not lift the wide open ring up a few centimetres, but tries to pull out or break off the nail! *The final solution is that the stick itself is broken above the middle with a great effort, and the objective reached with the free part.*

On repeating the test with a new stick Sultan notices the movements which the ring makes on the nail (when pulled towards the bars); he touches the ring as if examining it, and then takes it off with one quiet clear movement. The next time, none the less, he pulls first of all towards the bars before turning to the ring and pulling it off again in one sure movement.

Grande, Chica, Rana, and Tercera first pull at the stick and endeavour persistently to solve the connexion " rope-stick "; under their impatient movements the ring on the nail gets out of position, and it even slips off; but the animals do not notice this in their absorption in disconnecting the stick from the rope, and the ring could always be put back on the nail when they were not looking. The following is the limit of this behaviour: Rana accidentally pulls the ring from the nail, sits close to the bars, not noticing that now the stick is free to be used; the observer again puts the ring back over the nail unobserved by the animal, and immediately afterwards Rana pulls in the direction of the bars. When the same accident again occurs, and the rope hangs in the air with the ring free, the animal realizes only after a while that the stick can now be moved freely and that the connexion between it and the *rope* does not matter any more. The animals named did not at that time reach a genuine solution of this problem.

As the chimpanzees want only to have the stick and, as the next part of the whole arrangement, the rope, is so thin and flexible as to invite being torn or chewed, the attention of the animals becomes fixed on it to a surprising extent; efforts made to help them out of this were of no avail. Therefore, in later experiments, the rope connexion was omitted, the ring being nailed on the end of the stick, but in such a way that the greater part of the opening stuck up above the wood of the stick; and, in order to make chance solutions still more difficult of occurrence, I replaced the nail of the former

experiments by an iron bar, standing out about thirty-five centimetres vertically from a heavy box.

(10.5) Rana pulls at the stick in the direction of the objective and does not take any notice as yet of the ring; as the stick will not come off, she finally upsets the whole box by her tremendous straining in the direction of the bars; thus the stick falls off. The observer has the impression that instead of the ring round the iron bar, any other objects of equal total size could be used; this would not matter very much to Rana; it does not occur to her to look at the thing.

(14.5) Rana this time pulls so hard in the direction of the objective that the iron bar in the box bends a little, and the ring slips off; the animal scarcely understands why the stick suddenly becomes loose in her hand.—The next time when Rana pulls, the bar does not give way; she thereupon has a good look at the critical spot, pushes the ring up a bit higher, *but directly afterwards begins to pull as before in a horizontal direction.* This clumsy proceeding goes on so long and so violently that the nails which hold the ring to the stick become bent, and the stick is let loose! (If one behaves foolishly in such a situation, one has to pay for it with many foot-pounds of work; the nails used in this instance were very strong. On the other hand to lift off the ring would have meant a minimum of work, and we see from this small example of what fundamental importance for a *technical* consideration of the organism is the degree in which the handling of things is determined by a clearly-grasped structure of forms in space. Entirely apart from all psychology, it is of the greatest interest to every technologist to see cleared up the properties and processes of an organism—a material system after all—which cause such far-reaching physical differences.) In the following experiment Rana, surprisingly enough, does not pull at the stick at all, but raises the ring, without further ado, over the top of the iron bar, so that one might really think that it was

an intelligent action, the experiment is at once repeated and Rana this time pulls sideways quite primitively. In two further cases horizontal pulling at the beginning is each time followed by quick and sure lifting of the ring.

(11.5) Grande is tested in the same situation. She pulls at the stick in the direction of the objective, without casting a glance at the place where it is fastened, and then, for a time, stops bothering about the task. When the other animals are fed outside, she starts pulling again, but just at this moment (no doubt by chance) she looks at the ring, and a slight upward movement of it (perhaps five centimetres) does not escape her. This works upon her immediately, like the chance assistance in the board test: Grande goes up to the thing and, with one single movement upwards, lifts both the ring and stick.

(12.5) In two experiments, one after the other, Chica at once accomplishes the solution.

It might very well be thought that, after this, the animals would in future retain this simple proceeding as an assured possession, and if the ring, which is pulled over an iron rod (nail) were a visual fact, as simple and crude as "a-box-in-the-neighbourhood-of-a-vertical-distance-which-has-to-be-bridged," the animals would really be able easily to accomplish its release. But that is by no means always the case. Sultan tries to solve (19.5) such a combination (ring-nail) but moves round about it in an aimless way and, finally with a violent movement which pays no heed to the nature of the fastening, only succeeds through sheer strength, and pulls the ring down. In further tests I have seen the same animal take off the ring (or loops of rope) with all possible care, from nails, rods, boughs of trees, but I have just as often seen him blundering around the same combinations. On one occasion later, Grande actually succeeded with great effort in accomplishing a solution by dragging the iron bar on which the ring hung out of its fastenings, rather than by the already known and apparently

so simple method of taking off the ring ; the iron bar is then used instead of the wooden stick ! But, on another occasion, when she begins to loosen the iron bar, this is obviously done only in order to free the wooden stick ; and yet the ring had already slipped so far up the iron bar and somehow remained there, that a very slight lift would have accomplished the solution (19 5).

The question discussed here would not be better answered if one tried to bring about in further experiments the clear accomplishment of this small performance. By such practice, one would probably obtain the regularity desired ; but that the apes treat one and the same problem, sometimes blindly, and at the other times with perfect clearness, is just the characteristic thing about these animals. The most obvious explanation of their behaviour would seem to be that they always find the clear solution, when they clearly grasp the structure of the connexion, and, on the contrary, that they pull at it crudely when they are not able to achieve this clearness. The ring over the bar (the nail) seems to represent to the chimpanzee an optical complex which may still be mastered completely, if the conditions are for the moment favourable, if there is concentration of attention and so on ; but it has a strong tendency to be seen less clearly if the animal fails to make the proper effort on its part. We therefore here approach more difficult structures as, e.g., the " coiled rope ", " relation of shapes of boxes ", and so on, which rarely suggest definitely to the animal what movements it has to perform. Anyone who undertakes such examination will observe only too quickly that the animals do not always enter into the experiments in an equally calm and attentive way. The smallness of the spatial forms that are here under consideration might very likely add to the difficulties of the task of grasping them clearly ; the experiments that have been described up till now have usually been made in situa-

tions, whose parts are purposely interrelated in forms that are not only simple but also big.

[As presumably the structural complex dealt with often remains obscure, there cannot quickly arise a state of mechanization in which by a mere glance towards the complex the appropriate curve of movement appears. This would only be possible if the structure " ring-nail " itself could be established by practice once for all, thus creating the conditions for the reproduction of a mechanical proceeding. This establishing should be possible with the chimpanzee, according to my experiences ; but it is of no interest here.]

The observations recorded show also that we have now left the field in which the experiments give simple and decisive answers to our questions. It lies not in the experimentation[1], but in the nature of the animals, if the results become gradually less and less clear ; in the animals' visual and other brain centres also, things may well become less and less clear, as the experimental conditions reach a certain degree of complexity. If we had not made the acquaintance of the chimpanzees in optically simpler situations, we should have found it difficult now to take any position at all as to their behaviour. And yet many experiments with mammals have begun with the treatment of just such complicated situations, as if they were simple ; results in such cases must either be equivocal, or, with the increasing complications, must turn out negative, and then no conclusions of any value to the fundamental question of insight can be reached.

Variation of the experiment. At the height of a man, a rod two metres long is fixed to the wall of a house, so that it stands out at a right angle ; a little basket, with the objective in it, is hung by its semicircular handle on the rod, about one metre twenty centimetres from its free end. A little to the side, on

[1] At any rate I am sure that anyone who approaches similar tasks can now avoid mistakes which I made.

the ground, lies a long stick. (11 8) Sultan is brought in; he looks up at the basket, wants to climb up along the beams of the house, but is hindered, and, glancing round about him, remains squatting on the floor near by. It is only after some seconds, when his eyes have been directed to the stick close to him, that he seizes it and rushes towards the basket. Twice he beats at it, blindly and simply, in the oblique direction that his position happens to determine, then he suddenly changes the direction by 90° towards the correct side and, in a cautious movement, moving it six times carefully, pushes the basket towards the free end, until it falls down.

Grande in the same situation drags a box from far away, places it under the basket, mounts on it, but does not reach the basket. She fetches the stick, but lets it drop immediately for no obvious reason, and runs to a second box at a distance of about fifteen metres. Whilst she is busy pulling it over the intervening distance and not looking at us, the first box is removed and hidden. Immediately afterwards, the animal arrives with the second box, places it in position, mounts on it, and still does not reach the basket; she looks around with an expression of astonishment, and finally turns to the observer wailing. Left without assistance she again seizes the stick and, from the very beginning, pushes the basket down over the free end correctly and without making a false movement on the way. On repeating the experiment, on the other hand, Grande works the basket a few centimetres the wrong way, towards the house-wall; then, abruptly, reverses the movement by 180°, and pushes the basket along the stick steadily, until it falls.

[The complaining in the midst of the experiment was not provoked only by the fact that the animal did not succeed; for the looking around that preceded it was undoubtedly full of astonishment, and the wailing carried a note of indig-

nation. The other box was missed, as soon as the need for a second building-block was felt.]

The experiments mentioned at the beginning of this section convey, besides the roundabout way of dealing with objects, yet another principle : the objective is put by the use of tools into a position in which it can be reached only by changing the position of the animal's own body afterwards. In the case described above, however, this procedure has been facilitated very much for the animals, inasmuch as afterwards they only need make one or two steps sideways, thereby remaining at the same bars at which they have worked from the beginning with the stick ; these bars, furthermore, are so well known, that " near the bars " (at whatever place) and " attainable ", " accessible-to-me ", ought to be very closely connected to the animal. One may sharpen the conditions of the experiment essentially by requiring the animal to " take into consideration ", during the use of the tools, a greater subsequent changing of the position of his own body, so that he works at first in one certain spatial orientation, for quite a different later one. The total " curve of behaviour " is formed in such a case by two lines running in *opposite* directions, whilst the experiments last considered (for instance, with the detour-board) move on the same total curve in a single movement of one direction only.

A big wooden animal cage is closed on one side by bars, between which the animals can pass their hands from outside ; but the cage is so big that the arm of a young chimpanzee standing outside does not command the whole interior from these bars, but only about half of it. The side opposite the bars consists of boards nailed across horizontally ; one board is removed, at a place that enables the young animals to look and put their hand into the cage, but not touch the floor ; the rest of the cage is closed. If a piece of fruit lies on the

floor close to the wall from which a board has been removed, the chimpanzee will reach after it from the (opposite) bars with a stick, as the cage (weighted with stones) cannot be turned over. If one takes care that the stick can be used only from the side of the gap (where one board is removed), the sole solution remaining is to push the objective from the gap towards the bars, until it can be reached there with the hand, One therefore removes all possible sticks and staves except

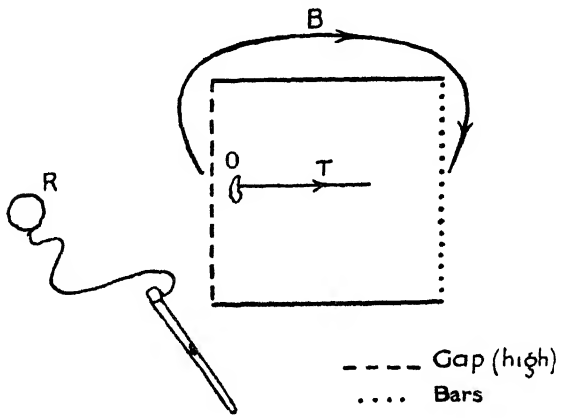

FIG. 19.

one which can be used quite comfortably from the gap, but, being fastened near the gap by a rope tied to a tree, cannot be taken over to the side where the bars are. (Fig. 19 shows only the ground-plan : R is the tree with the rope and the stick attached to it ; the broken line indicates the side with the gap ; opposite, the bars are indicated by a dotted line. The lines T and B indicate the two parts of the total procedure running towards each other, one of which is to be covered by the tool, the other afterwards with the animal's body. It is clear that the ape has to work for a later position of its body, which is, as it were, the reverse of the position taken during the use of the tool.)

(27.3.1914) Sultan seizes the stick, pokes with it through

the gap, and tries to pull the objective towards him and to lift it up the side to a height where it can be reached. From time to time he runs off, looking for a blade of straw, or somethink like it, with which to reach for the objective from the side of the bars—but in vain. After a while—the animal is again using the stick from the gap—the whole direction of the movement suddenly changes; the objective is pushed away from the gap, not to the bars, but to a spot where in one of the sides below, about half-way between the gap and the bars, there is a little hole in the wood. Sultan proceeds very carefully, brings the objective in front of the small hole with the stick, then drops the tool, goes round to the place outside the hole, and makes a great effort to squeeze out the fruit with his fingers—but the hole is too small. He soon again approaches the gap, again seizes the stick, and now changes the position of the objective in a way which I could not clearly understand, but probably still counting on that hole, and in any case getting close to it. In doing this the goal comes across the middle of the floor of the cage, a little closer to the side of the bars. All of a sudden, Sultan drops the stick, runs round to the bars, puts his arm through them as far as he can, and actually reaches the objective. The impression upon the observer after this proceeding is *not* that Sultan has immediately before worked in the direction of the bars and now comes round to complete the success thereby rendered possible; it looks rather as if he once again had abandoned the use of the stick in order to try his luck from the bars, as he had done several times before. As the attempted solution with the hole in the wall after all contains the method required, although in a simpler form, and since a human being would probably consider the accidental success just described as a strong help to the animal, all depends now on what he does upon repeating the experiment.

A new objective is put in the place where the first one

was. Sultan seizes the stick and *pushes the fruit straight towards the bars*, without taking any further notice of the hole in the side. On the way, one notices several times indications of the " changes " into the (biologically evidently very strong) direction of o°[1], observed in Chica and Nueva, but never before in Sultan : inasmuch as the stick is placed, erroneously, *behind* the objective, for a moment the movement of pulling is made, and if the correction were not made immediately, the objective would return to Sultan. As a matter of fact, the total of the small backward pulls towards himself amounts only to a few centimetres, as the animal itself soon realizes what it is doing. Sultan makes the whole course unnecessarily long, as he does not take into account the length of his arm ; with the greatest effort he pushes the objective right up to the bars, that is to say, a distance of about one metre, and finally gives the fruit a push with the stick (which is a little too short for the operation) so that it falls out on the ground between the bars. But in that same moment he is already running round the cage, and gets the objective. The very deviation from his behaviour during the previous chance success (when he reached far into the cage) proves that after this bit of help a genuine solution of the problem has arisen.

At a repetition of the experiment Sultan nevertheless reaches for the objective from the side of the bars, with a straw, before he goes to the gap and solves his task. He achieves it without a " change," but again disregards the length of his arm, and makes unnecessary efforts to push the objective with his short stick right over to the other side. During the third experiment the procedure is perfectly clear ; Sultan stops pushing when the fruit is still a good distance from the bars, drops the stick and runs round.

[1] It seems to me quite impossible that this is only a question of a sudden change into an " accustomed " way of using the stick. At 90° the animals *push* the objective without any inhibitions.

Chica likewise hits upon the solution (30.3) with chance assistance. She first of all pulls the objective towards her at 0°, and when she tries to lift it up the wall, it drops, and bounces awayf rom her to about the centre of the cage-floor. At the same moment the animal runs round the cage, passes her arm through the bars, and reaches the objective.

As with Sultan, the consequence of what has thus happened is, that, in the next experiment, *from the very beginning, the direction towards the bars is clearly taken.* There is no doubt that this is the beginning of the solution. But now occurs one of the strangest performances that I have ever noticed in these animals. During the board experiment Chica had already frequently turned off from the right track (180°) and, for moments, reverted to the primitive direction (0°). While working now perfectly correctly and clearly towards the bars opposite, she is startled by a noise from the street, looks for an instant towards the scene of the disturbance, and then continues her activity, *but now pulling at* 0° ; this time, the change is *not* corrected. Chica continues pulling until the objective is brought close up to her under the wall with the gap ; and *at this moment, like some one who has nothing more to do than to reap the fruits of his efforts, she runs round the cage to the bars* ; nobody could look more nonplussed than Chica, when she peered into the cage and saw the objective as far as it could be from the bars. It looked as if she had just been awakened out of a dream, and, judging by the usual behaviour of a chimpanzee, the only explanation that can be given for this performance is that the disturbance had a long after-effect, and that, under these conditions, particularly favourable for the change, it was not noticed and corrected as usual. In this way Chica brought the objective up to the natural end of its track, and then proceeded, still " absent-mindedly ", to the second part of the programme, which now, of course, did not fit in, and thus led to the " awakening."

After the surprise, the animal returns to the wall, seizes the stick again, and pushes the objective with great care towards the bars; but even now she cannot avoid changes, although she always corrects herself immediately. Chica takes as little account as Sultan did at first of the length of her arm, and goes on pushing the objective towards the bars long after she could have reached it comfortably.

Next time, the solution is again worked out clearly from the very beginning. Chica does not once resort to the primitive direction, and indeed runs round to the bars before she has pushed the objective far enough towards the other side, thus showing, of course, that she has "calculated too favourably" her arm-length; she returns once more to the gap, gives a few further pushes to the objective, and then completes the solution.

Two further repetitions on the following day result in clear procedures, with the exception of short tendencies to changes, which are corrected immediately.

I tried to test Rana also with such an arrangement, but soon had to give it up, as she seemed to consider it a point of honour not to deviate from 0° in any circumstances, and she could not be diverted by any sort of help, not even by repeated examples.

(Since the experiment just described has some similarity with that of the "roundabout-way board," it must be pointed out that it was undertaken *about a week later*. Sultan had already taken roundabout ways (on 18th and 19th March), at 180°; Chica had failed when the board was in the normal position. The next board experiments took place a month and a half after the experiment just described.)

The experiments with the basket—mentioned in the Introduction—with rope, ring, branch stump, or nail, partly belong here, because in those, too, the animal had to find a solution at *one* place which would only work out as a solution

at *another place*, after a detour. Further tests with that arrangement will be reported in a continuation of this book.

The board experiment and the tests described thereafter require, it is true, some adaptation of the movement to the given forms, but neither the things with which the proper roundabout ways are to be made, nor the structure of the field need be conceived with great precision as far as form is concerned, to achieve a solution. In fact, the solution was achieved on a very large free field.[1] If anyone wants to go on to higher demands, there is the exact fitting of one form which the animal is using, to another. Investigations along this line, which might be of the greatest importance for an understanding of the theoretical nature of intelligence, do not generally lead to very gratifying results with chimpanzees, and from our experiences up to date, failures and obscure behaviour are the only results we can expect in difficult cases of this sort.

(25.3.1914) Sultan tries to reach the objective placed behind the bars, with a stick, one end of which is bent into a crook. He seizes his tool by this crook, to poke it between the bars, and gets stuck with the crook caught behind one of the bars. This mishap leads to a hasty ramming against the obstruction, the factor of shape not being taken into account, and, when the stick is eventually freed, one has the impression that it was accidental. Some repetitions proceed in a similar way.

Two years later (in May 1916) the experiment is made with the same stick, in order to find out whether the animal is now capable of any greater clearness. As a matter of fact, Sultan, quite unmistakably, manages to keep the crook perpendicular, to fit the structure of the bars. He does this

[1] Only the experiment with the ring and the nail approximate to the following tasks in this respect.

while the crook is still far away from the bars, and so succeeds without difficulty; in a few cases where he acts with less caution, and gets caught behind a bar, he quickly glances at the place of obstruction, and every time pulls the stick back and turns it, so that it can be got through without any further difficulty. During this experiment the animal behaves more calmly than in the earlier one.

[Sultan seems not to notice or to realize the advantage which the crook offers, for instance, to pull a banana to him; according to how he has picked up the stick, he puts the crook behind the objective, or else uses the point, as with every other stick. Nueva, who from the very beginning, got the hook through the bars without trouble, may perhaps have recognized its advantage.]

Across one end of a stick about eighty centimetres long, a second stick of thirty centimetres is nailed, so as to form a "T." Otherwise the task is the same as in the previous experiments.

(2. and 3.4.1914) Sultan endeavours to break off the cross-bar; when this fails, he pushes the long part through the bars; the cross-piece catches, and the animal rams it violently, blindly, and continually against the bars, until finally, obviously quite by chance, the cross-piece happens to be turned, so that it no longer sticks. After about twenty repetitions, no observable improvement occurs; it is evident that no attention is paid to shape.

Chica proceeds somewhat more quietly, but otherwise no better; after a series of observations, I was forced to note that she did not even *attempt* to arrive at clearness.

Sultan is tested again with the same "T"-shape in 1916. As in the crooked-stick experiment, an essential improvement has occurred, inasmuch as the cross-piece, from the very beginning, while still at some distance from the bars, is held vertically, so that it can be got through the bars. *One has*

the impression that Sultan is being taught by the forms which he sees, what to do when stick and bars are opposite each other, but not yet in optical contact. As soon as, through carelessness or haste, close optical contact of stick and bars has come about (without a vertical turn in advance), Sultan's further procedure depends on the special configuration in each case; if the long piece is in a position perpendicular to the surface of the bars, while the cross-piece is stuck behind a bar, the latter is generally turned up with one sure movement, and thus put through; this is specially true in the cases where the twist required forms a small angle (as was to be expected from previous experiments). *When, on the other hand, the long piece itself lies aslant, and the region round the junction of the two sticks forms, with the bars, a relatively confused combination of lines, then Sultan pulls and jerks blindly at his tool.* He is similarly perplexed when he wants to get the whole thing in from outside, and gets it muddled between the bars; he then simply tugs without paying any attention to shape. Not every complex has the qualities of a good and precise "*Gestalt*", and even for the human being who looks on, the cases that are not clear to Sultan constitute "less good forms", and therefore give no direct indication of the motions required.

The forms which are to be handled in relation to other forms are still more difficult to grasp visually. The ladder previously mentioned lies crosswise outside the bars and must be brought in so as to reach an objective high up.

(12.5.1914) Grande and Chica seem to regard the task as impossible; in their discouragement they hardly touch the ladder.

Sultan at first behaves in the same way. After some time, however, he seizes the ladder, pulls one end across

between the bars, and tears it wildly towards the inside, although he cannot possibly achieve a solution thus. In his pullings and haulings the ladder finally goes somehow between the bars. In the course of a few repetitions the observer notices certain differences. Not every junction of ladder and bars is treated in an equally unintelligent way; on the other hand, some factors occur like those already mentioned in the previous experiment. Sultan does not know how to help himself out of that criss-cross mix-up which puzzled him also in the "T"-shape case; on the other hand, some of his twists are genuine, when the ladder is only a little out of the proper position. In general, then, the animal's movements are more or less clear according as the aspect of the lines of ladder and bars taken together is clear.

This experiment is repeated again later (in May 1916). The total impression of Sultan's behaviour is unfavourable as before; we cannot fail to recognize that intelligent behaviour alternates with quite absurd pulling and tearing, as the combination of forms of ladder and bars alternates from simple to complicated. But even for the human adult there are many cases and moments of optical "confusion", although the observer, by a little effort, can always recover the required clearness.

The ladder experiment suggested to me that the test would be very much facilitated by introducing a solid form instead of the combination of lines used up to now (of ladder and "T"-shape). Therefore, the following situation is set up: the objective lies in a big box, and can only be reached from one opening, which is cut rectangularly in one of the sides (about ten by three centimetres); the objective, however, is so far away from this opening that a wooden board—the only stick in sight—must be used to get it. Its cross-section repeats on a small scale the rectangular opening, and, when

turned the right way, it can easily be put through the opening into the box. (The animal can look inside the box through other cracks, and the cross-section of the board is so much smaller than the opening that this implement can easily be managed.)

(6.4.1914) In this test both Sultan and Chica act without much "order". Both show that they are by no means indifferent to the forms before them, for they soon turn the board into the position *approximately* required before they get to the opening. But, if there is the slightest check at one corner, this failure does not have the effect of teaching them to be more careful; on the contrary, they push and jam the board only the more wildly and blindly, until finally their behaviour shows no regard whatever for the forms with which they are dealing. (There are adult men who, in similar situations—fighting with collar studs and so forth—behave similarly; the fault here lies more in the emotional field, in character and "education", than in the purely intellectual field; anyhow, from a practical standpoint the result is that the processes proper to intelligent conduct no longer occur in the degree otherwise possible, as soon as intense emotions master the organism.)

I do not report further variations on the principle of these experiments, as the results were always the same: with the cleverest animals a clear adjustment to forms, as long as the given structure remained clear and simple; on the other hand, even with the most gifted ones, a completely unintelligent pulling and pushing as soon as forms were at all complicated. After many experiences in this field it becomes more and more certain that impatience and temper are not alone to be blamed for this; the same difference is also to be noted on the animals' good days, and when they went quietly to work. The more gifted chimpanzees show a certain improvement at the age of about five to seven years, but the two older animals,

Tschego and Grande, are not ahead of Sultan (to say nothing of Nueva), in proportion to their age. As far as Nueva is concerned, we have to report certain data concerning her command of forms in another connexion.[1]

If the less gifted animals have not been mentioned very much in this section, it is to be attributed only to the fact that there is little to be said about this unintelligent treatment of forms, even those that are relatively simple ; the experiment with the detour-board may serve as characteristic of them all.

[1] See Appendix.