V

THE MAKING OF IMPLEMENTS—(*cont*)

Building

When a chimpanzee cannot reach an objective hung high up with *one* box, there is a possibility that he will pile two or more boxes on top of one another and reach it in that way. Whether he *actually* does this seems a simple question that can soon be decided. But if experiments are made, it is quickly seen that the problem for the chimpanzee falls into two very distinct parts: one of which he can settle with ease, whilst the other presents considerable difficulties. We think the first is the *whole* problem; where the animal's difficulties begin, we do not, at first, see any problem at all. If in the description this curious fact is to be emphasized as much as it impressed itself on the observer, the report of the experiment should be divided into two parts in accordance with this fact. I shall begin with the answer to the question that seems to be the only one.

In one of the experiments described previously (p. 46), Sultan came very near putting one box on the top of another, when he found one insufficient; but instead of placing the second box, which he had already lifted, upon the first, he made uncertain movements with it in the air around and above the other; then other methods replaced these confused movements. The test is repeated (8.2); the objective is placed very high up, the two boxes are not very far away from each other and about four metres away from the ob-

jective ; all other means of reaching it have been taken away. Sultan drags the bigger of the two boxes towards the objective, puts it just underneath, gets up on it, and looking upwards, makes ready to jump, but does not jump ; gets down, seizes the other box, and, pulling it behind him, gallops about the room, making his usual noise, kicking against the walls and showing his uneasiness in every other possible way.[1] He certainly did not seize the second box to put it on the first ; it merely helps him to give vent to his temper. But all of a sudden his behaviour changes completely ; he stops making a noise, pulls his box from quite a distance right up to the other one, and stands it upright on it. He mounts the somewhat shaky construction, several times gets ready to jump but again does not jump ; the objective is still too high for this bad jumper. But he has achieved the essential part of his task.

(12.2) Some days previously Chica and Grande learnt from Sultan and myself how to use *one* box ; they do not yet know how to work with *two*. The situation is the same as in Sultan's experiment. Each of the animals forthwith seizes a box ; first Chica, then Grande, will stand under the objective with her box, but there is no sign of an attempt to put one on top of the other. On the other hand, they hardly get up on their own boxes ; though their feet are lifted, they put them down again as soon as they glance upwards. It is certainly not a matter of accident, but the result of that upward glance at the objective, when both Chica and Grande proceed to stand the box upright (compare Sultan, p. 46) ; a measurement of the distance with the eye

[1] All the animals showed a strong aversion to the room in which these experiments were carried out, not because of the experiments—those they did not mind—but because of the unbearable dry heat that existed there most of the time. In those days, for outside reasons, I could not make my experiments anywhere else, but later I avoided the room whenever possible Some stupidities that were observed here were very likely, partly symptoms of fatigue.

leads to this change of plan ; it is a sudden and obvious attempt to meet the needs of the situation. Finally, Grande seizes her box and tears about the room with it, in a rage, as Sultan did before. Just as he did, she calms down unexpectedly, pulls her box close to the other one, after a glance at the objective, lifts it with an effort, puts it clumsily on the lower one, and quickly tries to get up on it ; but when the upper box slips to one side during this operation, she makes no move, and lets it fall altogether, quite discouraged. In principle Grande solved the problem too, so the box is lifted by the observer, placed firmly on the lower one, and held there, while Grande climbs up and reaches the objective. But she does all this with the greatest mistrust.

(22.2) Grande, Chica, and Rana are present. Grande carries first one, then the other box underneath the objective, but handles them in such a way as to create the impression that she is perplexed ; she does not put one box on the other. This looks very like the condition of " lack of direction " which sometimes influenced Sultan and Chica when dealing with the two bamboo sticks. Suddenly Chica springs up beside Grande, puts one box on the other without further delay, and gets up on top. It is hard to say whether this was an after-effect of the previous attempt and Grande's example, or an independent solution, helped perhaps by Grande's " messing round ".

A new objective is hung up ; Rana now puts one of the boxes flat underneath the objective and the second one immediately on top of it (also flat) ; but the arrangement is too low, and the animals prevent each other from improving it, as they now all want to build on their own, and at the same time. Knowing Rana, I am inclined to assume that this is a case of imitation of what she has just seen, or, at any rate, what she saw was of great help to her , but this question is not important here.

A number of further experiments, which, however, did not quickly lead to greater assurance, as in other cases, will be described later. After the animals had become accustomed to putting one box on another as soon as the situation called for it, the question arose as to whether they would make further progress in the same direction.

The tests (higher objective, three boxes at some distance) first resulted in Sultan carrying out more difficult constructions, with two boxes on top of each other, perpendicularly so that they looked like columns, and, of course, enabled him to reach very high (8.4); he took the third box, to being with, to the place of construction, but left it standing beside him without using it, as he could then reach the objective by means of his column without it.

(9.4) The objective hangs still higher up; Sultan has fasted all the forenoon and, therefore, goes at his task with great zeal. He lays the heavy box flat underneath the objective, puts the second one upright upon it, and, standing on the top, tries to seize the objective. As he does not reach it, he looks down and round about, and his glance is caught by the third box, which may have seemed useless to him at first, because of its smallness. He climbs down very carefully, seizes the box, climbs up with it, and completes the construction.

Grande in particular progressed with time. Of the smaller animals she was the strongest and by far the most patient. She would not allow herself to be diverted by any number of mishaps, the collapse of the structure, or any other difficulties (partly created involuntarily by herself), and soon was able to put three boxes on top of each other, like Sultan (see Plate IV). She even managed once (30.7. 1914) a beautiful construction of four boxes, when she found a fairly big cage near by, whose flat surface allowed of the addition of the three remaining parts with safety. When, in the spring

of 1916, an opportunity was again given for making higher constructions, Grande was still, even after this long interval, relatively the best of them all and quite as good an architect as before. High constructions composed of four objects gave her some difficulty, but with obstinate effort she managed them with considerable success (see Plate V).

Chica also builds towers composed of three boxes without too many mishaps, but has not become so expert as Grande, because, impatient and quick by nature, she prefers dangerous jumps (with or without a stick) from the floor or from some low structure to the slow process of building. And in these she is often successful, while Grande in her own way has still a good deal of hard work to get done.[1] Rana scarcely gets beyond two boxes. Whenever she has got so far, she stops, and either goes on endlessly trying out miniature vaulting-poles, or else (a frequent occurrence) she places the upper box open side up, and then carries out an irresistible impulse to sit down beside it ; once she is there, she feels too comfortable to get up again and to continue building. Konsul never built, Tercera and Tschego got no further than some feeble attempts, Nueva and Koko died before they could be experimented with.

Without doubt, constructions such as those achieved by Grande (see illustrations) are considerable feats, especially when one considers that the constructions of insects (ants, bees, spiders) and other vertebrates (birds, beavers), though they may, when finished, be more perfect, yet are built by a very different and much more primitive process, from an evolutionary point of view. The following accounts will show that the difference between the clever but clumsy constructions of a gifted chimpanzee, and the firm and objectively elegantly-spun web of a spider, for instance, is one of *genus*,

[1] Chica sometimes also uses the stick to beat with, instead of as a jumping-stick (cf Plate VI)

which, of course, should be obvious from what has been already said. But, unfortunately, I have been asked by otherwise intelligent spectators of these constructions, " whether this is not instinct " ? Therefore I feel obliged to emphasize the following particularly : the spider and similar artists achieve true wonders, but the main *special* conditions *for this particular work alone* are within them, long before the incentive to use them occurs. The chimpanzee is not simply provided for life with any special disposition which will help him to attain objects placed high up, by heaping up any building material, and yet he can accomplish this much by his own efforts, when circumstances require it, and when the material is available.

Adult human beings are inclined to overlook the chimpanzee's real difficulty in such construction, because they assume that adding a second piece of building material to the first is only a repetition of the placing of the first one on the ground (underneath the objective) ; that when the first box is standing on the ground, its surface is the same thing as a piece of level ground, and that, therefore, in the building-up process the only new factor is the actual lifting up. So the only questions seem to be, whether the animals proceed at all " tidily " in their work, whether they handle the boxes very clumsily, and so forth. I myself never expected to be faced, through my observations, by a wider, and very much more important, question. That another special difficulty exists, however, should become obvious from the further details of Sultan's first attempt at building. May I repeat : When Sultan for the first time fetches a second box and lifts it (28.1), he waves it about enigmatically above the first, and does not put it on the other. The second time (8.2, compare p. 135) he places it upright on the bottom one, seemingly without any hesitation, but the construction is still too low, as the objective has accidentally been hung too high up.

The experiment is continued at once, the objective hung about two metres to one side at a lower spot in the roof, and Sultan's construction is left in its old place. But Sultan's failure seems to have a disturbing after-effect; for a long time he pays no attention at all to the boxes, quite contrary to other cases, where a new solution was found and usually repeated readily (though Koko once forgot a solution). It may well be that for the chimpanzee (as for man) the practical "success" of a method is more important as an estimate of its value, than is really justifiable. (This is judging *ex eventu* in the bad sense.)

[It occasionally happens that one will start working at a mathematical or physical problem with perfectly correct premises, and calculate or think up to a point where one gets lost. The whole proceeding is then rejected, and only later will one discover that the method was quite right, and that the difficulty was only a superficial one and could easily have been overcome. If, when the difficulty occurred, the logical relations had been the sole determinant, and if these had been carefully examined, the obstacle would at once be found unimportant. The less one takes into consideration all the relevant conditions, the more one will be embarrassed by an apparent failure. And so, it is not surprising that the chimpanzee, who does not grasp certain parts of the situation at all clearly, is influenced just as much by a mistake methodologically unimportant, as by an error in principle, and will then, because subsidiary circumstances spoiled the first attempt, give up the whole thing in despair. Grande furnishes a good example, when she suddenly puts a second box on the first one; the solution is not only objectively good in principle, it also appears with the character of genuineness; but as luck would have it, a corner of the top box is upon a board nailed across the surface of the lower one, so that when the animal begins to climb up, the box slips sideways, and then

and over again, as a footstool), I shall briefly add a description of similar cases: (19.2) Sultan cannot solve a problem, in which the objective is outside the bars beyond reach; I am near him inside. After vain attempts of all sorts, the animal comes up to me, seizes me by the arm, pulls me towards the bars, at the same time pulling my arm with all his might down to himself, and then pushes it through the bars towards the objective. As I do not seize it, he goes to the keeper, and tries the same thing with him. Later (26.3) he repeats this proceeding, with the only difference that he first has to call me with plaintive pleading to the bars, as this time I am standing outside. In this case, as in the first, I offered so much resistance that the animal could barely overcome it, and he did not release me until my hand was actually on the objective; but I did not do him the favour (in the interests of future experiments) of bringing it in.—I must mention further, that one hot day the animals had had to wait longer than usual for their water "course", so that finally they simply grabbed hold of the keeper's hand, foot, or knee, and pushed him with all their strength towards the door, behind which the water-jug usually stood. This became their custom for some time; if the man tried to continue feeding them on bananas, Chica would calmly snatch them out of his hand, put them aside, and pull him towards the door (Chica is always thirsty).—It would be erroneous to consider the chimpanzee unenlightened and stupid in these matters. I must add that the animals understand the human body particularly easily in its local costume of shirt and trousers without any coat. If anything puzzles them, they will investigate it on occasion, and any large change in the manner of dressing or appearance (e.g. a beard) will make Grande and Chica undertake an immediate and very interested examination.]

After the encouraging assistance to Sultan, the boxes are

again put aside. A new objective is hung in the same place on the roof. Sultan immediately builds up both boxes, *but at the place where the objective had been hung at the very beginning of the experiment and where his own first construction had stood.* In about a hundred cases of using boxes for building, this is the only one in which a stupidity *of this kind* was committed. Sultan is quite confused while doing this, and is probably quite exhausted, as the experiment has lasted over an hour in this hot place.[1] As Sultan keeps on pushing the boxes to and fro quite aimlessly, they are once more put on top of each other underneath the objective; Sultan reaches it, and is allowed to go. Only on *one* occasion did I see him similarly confused and disturbed.

The next day (9.2) it is clear that a particular difficulty must lie in the problem itself. Sultan carries one box underneath the objective, but does not bring the second one; finally it is built up for him and he attains the goal. The new one immediately replacing it (the construction was again destroyed) does not induce him to work at all; he keeps on trying to use the observer as a footstool; so once more the construction is made for him. Underneath the third objective Sultan places a box, pulls the other one up beside it, but stops at the critical moment, his behaviour betraying complete perplexity; he keeps on looking up at the objective, and meanwhile fumbling about with the second box. Then, quite suddenly, he seizes it firmly, and with a decided movement places it on the first. His long uncertainty is in the sharpest contrast to this sudden solution.

Two days later the experiment is repeated, the objective is again hung at a new spot. Sultan places a box a little aslant underneath the objective, brings the second one up,

[1] I only noticed later that I used to strain the animals a little too much during the first months; only with time did I develop the slowness of procedure adequate to the apes and to the climate.

and has begun to lift it, when, all the while looking at the objective, he lets it drop again. After several other actions (climbing along the roof, pulling the observer up) he again starts to build; he carefully stands the first box upright underneath the objective, and now takes great pains to get the second one on top of it; in the turning and twisting, it gets stuck on the lower one, with its open side caught on one of the corners. Sultan gets up on it, and straightway tumbles with the whole thing to the floor. Quite exhausted, he remains lying in one corner of the room, and from here gazes at both box and objective. Only after a considerable time does he resume work; he stands one box upright and tries to reach his goal thus; jumps down, seizes the second, and finally, with tenacious zeal, succeeds in making it stand upright also, on the first one; but it is pushed so far to one side that, at every attempt to climb up, it begins to topple. Only after a long attempt, during which the animal obviously acts quite blindly, letting everything depend on the success or failure of planless movements, the upper box attains a more secure position, and the objective is attained.

After this attempt Sultan always used the second box at once and, above all, was never uncertain as to where he had to put it.

The report shows that after the first independent solution, the boxes were arranged on top of each other for Sultan *four* times; in the experiments on Grande, Chica, and Rana, I gave the same amount of assistance three times after the first solution, which proved a good incentive to the animals to go on with that method. If I had let them get very hungry and then put them time and again into the same situation, they would probably have developed their building process without this interference. But what seemed to me more important, after my first experiences (instead of trying to see whether the chimpanzees would keep on building without

encouragement, proceeding to constructions of three and four parts), was to examine minutely their *method* of building; that was why, after they had once solved the first essentials of the problem, I encouraged them as much as possible to continue.

If putting the second box on the first were nothing more than a repetition of the simple use of boxes (on the ground) on a higher level, one would expect—after the other experiences—that the solution once found would simply be repeated. To Sultan and Grande it is quite a matter of custom—in the days of these experiments—to attain objectives by means of *one* box, as the tests show; but neither succeeded easily in reproducing his *building* methods, and one glance at the description of the experiments will show that the first failure (merely practical) is not alone to be blamed for it Neither is a quite external factor the chief cause: it is true that the boxes are heavy for the little animals, and there are moments in the course of the experiments when they simply cannot manage the weight. But one has only to see with what energy and success they generally carry and lift their burden, when they build at all, and how completely perplexed they may become, too, even when they have the second box high enough (from a human point of view) merely to let it sink on to the lower one, to realize that the animals do *not* omit further building merely on account of the physical effort. Rather, they will be a little clumsy to begin with. But too much stress must not be laid on this; for probably the abandoning of the method after the first trial, is connected, internally, with their other strange behaviour, their sudden fits of perplexity before the two boxes; and this behaviour has nothing to do with clumsiness. The animal does not behave then like somebody accomplishing a task clumsily, but like someone to whom the situation does not offer any definite lead toward a particular action.

This inhibition, perplexity, or whatever one likes to call it, which may befall the animals in their first attempts, when obviously the solution "put second box up" has already appeared and they are proceeding to carry it out, was observed three times in Sultan, twice in Grande, and clearest of all, later (in the spring of 1916) in the adult Tschego, on the occasion when she was to place one box on the other for the first time. I want to emphasize again that at first everything goes well; as soon as the animals are quite familiar with the situation, and are convinced that they cannot attain the objective with *one* box, a moment arrives when the second box is suddenly "drawn into the task". They then drag it up (Tschego) or carry it just to the first box and all of a sudden stop and hesitate. With uncertain movements they wave the second one to and fro over the first (unless they let it drop to the ground immediately, not knowing what to do with it, as Sultan once did) and if you did not know that the animals see perfectly well in the ordinary sense of the word, you might believe that you were watching extremely weak-sighted creatures, that cannot clearly see where the first box is standing. Especially does Tschego keep lifting the second box over the first and waving it about for some time, without either box touching the other for more than a few seconds. One cannot see this without saying to oneself: "Here are two problems; the one ('put the second box up') is not really a difficult task for the animals, provided they know the use to which a box can be put; the other ('*add one box to the other, so that it stays there firmly, making the whole thing higher*') *is extremely difficult.*" For therein lies the one essential difference between using one box on the ground and adding a second to the first: In the *former* case, on the homogeneous and shapeless ground, which does not claim any special requirements, a compact form is simply put down or else it is just dragged along (till underneath the objective)

without being taken off the ground at all. In the *latter* case a limited body of special shape is to be brought into contact with a similar one, in such a way that a particular result is obtained, and this is where the chimpanzee seems to reach the limit of his capacity.

A glance in retrospect will show immediately that the experiments before described with *one* box only on level ground, get over this difficulty; but they are misleading, and, therefore, cannot give an adequate idea of the chimpanzee. Either the little animal *pulls* his box almost underneath the objective, or he *rolls* it there. In neither case does it matter whether the box is some centimetres or even decimetres to the right, left, in front, or behind. The ground is the same level everywhere, and the objective, in spite of these small differences in position, is easily attainable[1] and, therefore, in the hands of the chimpanzee (who does not see any problem at all) the box automatically, with a few quick movements, reaches a position of equilibrium, in which it can be used. Quite different is the experiment with *two* boxes. Here the chimpanzee already meets a *static problem* which he must solve[2], since the first and second box do not solve it by themselves, as the first box and the level ground did.

[These observations and discussions lead to the conclusion that the chimpanzee will, without effort, place a small box on a very big box under the objective (the surface of the big box being both optically and physically more like the ground);

[1] Considerable mistakes of this nature, with reference to the objective, are easily and "genuinely" corrected (compare Koko); no factor of shape of any higher degree enters into consideration here, but simply "distance"

[2] Probably he seldom solves it "genuinely"; but it seems remarkable to me that cases occur (as those described) where at least the problem as a problem has an effect upon the chimpanzee and keeps him perplexed, since the solution does not appear. He could, after all, just let the second box drop somehow on to the first, and need not hesitate uncertainty may also be a good sign, on occasion

and, as a matter of fact, once, where a big cage formed the lower part of the structure, the second small box was immediately put firmly on top of it.]

There are two kinds of statics involving insight, just as there are (compare above, p. 75 seqq.) two ways of mastering lever action. The one kind, the physicist's (centre of gravity, movement of a force, etc.), does not come into question here any more than in those countless cases in which man "correctly" lays or stands some things on others. Unfortunately, psychology has not yet even begun to investigate the physics of ordinary men, which from a *purely biological standpoint,* is much more important than the science itself, as not only statics and the function of the lever, but also a great deal more of physics exist in two forms, and the non-scientific form constantly determines our whole behaviour.[1]

However the naïve statics of man may have arisen, even the most superficial observation will show that "gravity" on the one hand and visual forms in space on the other, play just as important a part in it as forces and distances, considered abstractly, in strictly physical statics. At least *one* of those "components" must be in a very undeveloped state in the chimpanzee; for the total impression of all observations made repeatedly on the animals leads to the conclusion that *there is practically no statics to be noted in the chimpanzee.* Almost everything arising as "questions of statics" during building operations, he solves not with insight, but by trying around blindly. And there can be no more striking contrast than that between genuine solutions arrived at suddenly and in one sequence, and the blind groping about with one box on the other, which is the procedure of construction when no lucky chance (like those described above) brings box on box, surface to surface. "Bringing a second box

[1] With experts, of course, this is saturated in all stages by physical science in the *strict* sense.

above the first one" (or a third or fourth—not realized as numbers, but as "more" or "others") no doubt still comes into the category of "genuine solutions", but the expression "to set one on top of the other" should be used with great caution, when meant to denote what the chimpanzee really does. These words suggest our (not necessarily scientific) human statics, and the animal possesses extremely little of this.

One may observe very similar facts in the first years of childhood. Very young children also, in attempting to pile one thing on another, try, by holding, and sometimes pressing, one against the other, to fix them in different and often curious positions. It is quite obvious that they too lack that kind of statics. But while human children, when about three years old, begin to develop the elements of this naïve physics of equilibrium, the chimpanzee does not seem to make any essential progress in this direction, even when he has plenty of opportunity to practise. For, although his uncertainty in the sphere of spatial forms and gravity soon discourages him less than at first (when he gives up all effort, in face of the conglomeration of boxes), yet even after success has strengthened his confidence, his gaily-undertaken work remains as much "mere trying" as at the beginning: a turning, pulling, twisting, tipping of the upper box on the lower, so that the animals, especially Grande, arouse admiration by their patience. One must not think that such a construction, even of three boxes only, can be accomplished in a few seconds; the more scope the boxes give for various accidents, the smaller they are, the more boards they are made of, the longer the animals will have to work, and it has happened that Grand kept on building up her structure for ten minutes at a time, then tumbling down with it, beginning again, and so on, until she was quite exhausted, and altogether unable to continue at all.

In the confusion of this method of construction some features are particularly characteristic. If the upper box is brought into a position in which it stands quite satisfactorily from a static point of view, but in which it may still wobble a little (this motion having no significance), it is often taken, or turned, out of this good position, if either hand or foot discover the oscillaiton ; for the optics of the position has here no further noticeable significance for the chimpanzee's control over the situation. If by chance, or in any other way, the upper box comes into any position where it does not for the moment wobble, the chimpanzee will certainly climb up, even though a mere touch or friction at some point has for the moment steadied the box ; really it may be quite unsteady and may fall over at once if weight is put on it. Thus Sultan, quite as a matter of course, once tried to climb up on the second box when it was precariously balanced on one corner only of the under one. Whether one box, for example, projects quite far out sideways from the rest of the structure or not, seems to be a matter of indifference to the chimpanzee —and sometimes the third box does not fall, only as long as the fourth and the animal remain on top of it and steady it by their weight. So one sees what happens when the chimpanzee deviates for the first time quite definitely from his optically-led treatment of the situation ; probably because it no longer serves to meet his needs. Structures grow under his hand, and often enough he can climb them, but they are structures which, according to the rules of statics, seem to us almost impossible. For all structures that *we* know (and are familiar with optically) are achieved by the apes by chance at best, and, as it were, by the "struggle for not wobbling." If Grande's first three-box construction is examined (see above, Plate IV, which, I hope, is clear enough to illustrate the point), it will be seen that it is scarcely capable of "life" ; it is not able to stand alone ; at the moment when

the photograph was taken, it actually was no longer standing of its own equilibrium, but thanks only to the well-balanced weight of Grande herself, who, in her turn, is holding fast to the objective above, and who cannot take it off or let go without tumbling down with the whole structure.[1] Such occurrences are quite frequent, only that the constructions often look even more perilous; usually the catastrophe happens before there has been a quiet moment long enough to take a photograph.

From this description it will be seen that the animals partly replace the missing (everyday) statics of human beings by a third kind—that of their own bodies, which is taken care of automatically by a special neuro-muscular machinery. In this respect, the chimpanzee, it seems to me, is even superior to man, and he obviously draws an advantage from this gift. When he is standing on a structure, the balance of which would fill an onlooker with fear, the first suspicious wobbling of the structure is counteracted in the most masterly fashion by an instantaneous altering of the balance of the body, by lifting his arms, bending his trunk, etc., so that the boxes, under the animal, to a certain extent, share the statics of his labyrinth and cerebellum. It can be said that in a great number of these constructions the animal itself, with the delicately-balanced distribution of its weight, contributes a certain element, without which the structure would collapse. But this is chiefly a *physiological* achievement, in the narrower sense of the word; there is no question of a real "solution". I must express a warning against an explanation which is too easy and quite inadequate in face of the actual facts, which would consider the animals merely too untidy and careless to build anything more stable. The animals' work may make this impression on a novice, but longer observation

[1] And immediately after the photograph was taken, the mishap occurred

of the tireless energy which Grande displays—as much in pulling down well-built structures because one part wobbles, as in building up structures which do not statically balance—will convince anyone that the real explanation lies deeper, and that, at least, those animals up till now observed, are chiefly hindered by the limits of their " visual insight "[1].

If the animals cannot even intelligently combine the building materials into one whole, it is not astonishing if they often are unable to understand or deal with an existing structure; for the corresponding (naïve) human faculties are missing, and can only be acquired with difficulty; nor is there any question of mere haste or untidiness here. So it will sometimes happen that Grande (and others too), while standing on one box, will try to lift another up in spite of its being open on one side, and a corner of the first box projecting into it. So, at least in part, Grande by her own weight, which rests on both boxes, hinders the lifting of the second box, but in spite of that she takes the greatest pains to drag it up, tearing and shaking it until, in a rage, she finally gives up trying to accomplish what she herself, without realizing it, is preventing. In the same way it may happen that Grande will be standing on a box supported at each end by two others, like pillars,[2] and that then one of the lower boxes will strike her as suitable for building purposes; if she can, she calmly pulls this out

[1] Nueva dealt with shapes in space so much more sensibly than any of the others, that one was led to think that she might have built differently, had she ever got as far as building experiments That there is an " *optical* weakness " must be taken for granted in any case, because even in the simple " gravitational physics ", " *gravity* " is for the most part determined optically

[2] Such a thing can *only* come about by chance Not once did the animals purposely pile up their boxes on the *bridge principle*, although in several experiments I tried to suggest such a proceeding to them, by hanging the objective high up, by placing heavy, solid pedestals at its right and left, and laying a stout board handy, so that they had only to place it across in order to reach the objective by standing on its centre The board was always used (by Sultan and Chica) as a jumping-stick Similarly all other experiments failed, in which the principle of using *two* forces at the same time plays any rôle.

at the side, and is very much startled when, together with the box on which she is standing, she tumbles to the ground (as must happen). I saw this even in 1916; there is simply no perceptible improvement.

[On the other hand the animals seem to learn that it is well not to turn the open side of a box upward in building, although this is not a matter of great importance; many constructions were built in which the second box lay firmly across the open end of the first. Nevertheless, this method of construction gradually occurs less and less.

Piling higher boxes on lower ones may be done from the ground or from the protruding edges of the *lower* boxes, but also in such a way that the animal, standing on the *topmost* one, pulls the next box up to it. The former proceeding is generally more practical, since the architect does not stand in his own way, as he easily may in the latter case. The animals all adopted it at the beginning. But in the building activities to be described later, in which the whole company joined, too much depended on keeping possession of the top, and so the second proceeding become customary.]

Sometimes it seems advisable to take one of the facts developed by observation, and demonstrate it in sharp outline by an extreme test. For this purpose the animals were confronted with the following situation: the objective is placed very high, a box lies near by, but the ground underneath the objective is covered with a heap of average-sized stones on which a box can hardly be placed firmly. (11.4.1914) Chica gets up on the stone-heap and endeavours in vain to reach the objective with her hand, and later with the stick; she does not pay any attention to the box, and, after a short time, not even to the objective. A second experiment, several hours later on the same day, proceeds in exactly the same way. This tells us nothing. It seems to me completely impossible that Chica should immediately see the stone-heap

as an obstacle, as she never reached such clearness of conception in much ruder obstacle-experiments; in any case she would at least make a try with the box. The test with the most intelligent of the animals, Sultan, had an entirely clear result, in the same situation and on the same day. He immediately pulls the box on to the stone-heap, but does not succeed in making it stand up, he drags a big cage from a distance, tips it onto the stones, sets the first one on top of it, and reaches the objective after fifteen minutes of very hard labour, though on a construction that stands crookedly up in the air. The stones are now heaped up into a pointed pyramid. But this time Sultan, by a series of lucky accidents, fixes his box onto the heap in a certain way in a few minutes, and again reaches the objective. At the third repetition—the pyramid having been built up again—he is not successful, and soon gives up his efforts. He did not make the least attempt, during the experiments, to move the stones and clear a level foundation.

On the following day the stones are replaced by a number of preserve-tins which are laid undereneath the objective in rolling position. Sultan immediately seizes the box and attempts to put it on the tins, whereat the box rolls off to the side over and over again. After fussing about with the box for some time, he pushes the tins (accidentally) a little sideways from the objective, so that a free place is made between them, big enough to place the box perpendicularly. But he makes further hard efforts to stand the box on the tins without paying the least attention to this free place. Nothing in his behaviour indicates any endeavour to remove the rolling tins, although he could do it in a few seconds without the least trouble. Finally the box is put accidentally on the ground and partly on the tins, aslant it is true, yet fairly firm, and Sultan reaches the objective. [The experiment with Sultan becomes all the more important as this animal takes out of the box the stones

which weigh it down the moment he realizes that it cannot be moved, he thus removes obstacles which he understands to be such. The same earlier experiment also showed that the chimpanzee did not have so much respect for obstacles set up "by the master" that he would not remove them. *This* is an anthropomorphism. Sultan does not consider at all how it comes about that strange objects lie under the objective, and as far as respect goes, he generally reserves that for the moment when, after an offence, the sad consequences actually occur; unless it is a matter which has been frequently forbidden, such as climbing along the wire-netting of the roof; which eventually did not happen often in my presence.]

In March, 1916, the same test was accidentally successful, Grande being the animal experimented with. Chica had in vain jumped for the objective with a short stout tree-trunk, and had then left it lying under the goal. Grande began to build, and at first on free ground; but when, on fussing about with the boxes, one of them tumbled under the objective and thus fell on the trunk, the animal changed its plan, and chose this box as a base. She took all sorts of pains to erect a structure on it, but, all the while, the foundation kept tipping and toppling on the trunk. Grande threw not one glance at the obstacle, any more than Sultan had at the tins.

According to these results, one can construct *a priori* a type of further observations. When the chimpanzee solves problems genuinely, which are only problems of "rough distance" from the goal, and at the same time hardly possesses or learns anything of our naïve statics, "good errors" are bound to occur, in which the animal makes real attempts to conquer the distance better—that is the good in it—but unconsciously aims at a static impossibility—that is the error.

The first of these good mistakes was observed in only two cases; it has a startling effect. (12.2) Chica tries in vain, in the first experiments, to attain the objective with one box;

she soon realizes that even her best jumps are of no avail, and gives up that method. But suddenly she seizes the box with both hands, holds it by a great effort as high as her head, and now presses it to the wall of the room, close to which the objective hangs. If the box would " stick " to the wall, the problem would be solved; for Chica could easily climb up and reach the goal by standing on it. In the same experiment, later on, Grande puts a box under the objective, lifts her foot to climb, but lets it drop again, discouraged, when she looks up. Suddenly she seizes the box and presses it, still looking up towards the objective, to the wall at a certain height, just as Chica had done. The attempt at solution is genuine: the sequence of movements, from " lifting up the foot " to " pressing the box to the wall " contains an abrupt break between " dropping of the foot " and " seizing the box "; and the proceeding " seizing—resolutely lifting it to about 1 m. high—pressing it to the wall," forms one single whole. Exactly the same applies to Chica's behaviour. It would be a wrong interpretation to say that the animals wanted to knock down the objective with the box. If that were their intention, they would deal with it quite differently, make different movements with it, and would lift the box straight up in the direction of the objective, not press it sideways to the wall, as both did from the very beginning. I will refer again later to this proceeding, for once really containing naive statics, even though chimpanzee-like and extremely primitive. [One might think that Grande was imitating what she had seen Chica do, but this seems very improbable to anyone more familiar with the chimpanzees' power of imitation. Furthermore, Grande's procedure is that of a genuine attempt at solution, and nothing would be changed if she had copied it, *it is most difficult for chimpanzees to imitate anything, unless they themselves understand it.*]

If the chimpanzee cannot reach his objective from a

box placed flat, he often turns it upright, after measuring the distance with a glance. There is a further development of this, which only has the defect that it is not compatible with the laws of statics. The animal stands on one box and places another in front of him and on top of the first, but a glance at the goal shows that the distance is too great. Then the upper of the two boxes is turned and turned again out of its position of equilibrium and "diagonally" (cf. Fig. 10); the animal tries meanwhile with grave concentration to ascend the heightened pinnacle. This attempt at solution can be repeated *ad infinitum* as the box certainly moves under the ape's hands, but remains in balance itself, to a certain extent, without much effort on his part. With an amazing stubbornness and minute care, Grande repeated this "good error" for years.

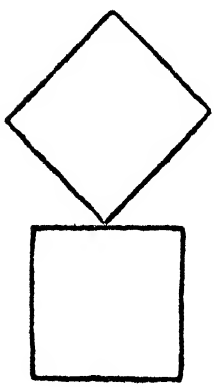

FIG 10.

To the preceding two a third example may be added, which, though not concerned with building, contains nevertheless a problem of statics. Chica tries to combine her jumping-stick procedure with building; she either begins her lightning-like climb from the top of the structure while the pole stands beside it, or she tries to prop up the pole *on the boxes*, if the building is firm enough, though, of course, she does not control it visually. If the boxes are so arranged that the top one lies with the opening uppermost, then the highest portions are the narrow edges of the boards composing its sides. *So Chica does not put her pole inside the open box*, but with all care *on its highest portion*, that is, on a point at the edge of the box, a surface about 15 mm. wide. Fortunately the pole always slips down before she has begun to climb properly, or she might easily have a bad fall. She does everything to

invite this catastrophe, and always props her pole on the edge. This is a "good" error, arising from understanding of some factors (height and approach to the objective) and complete blank innocence of others (statics).

The setting up of a ladder is, as a task, so like the piling up of boxes that I will pass on to it here. In both cases, when once decided these tools shall be used, there arises the special problem of making them ready for use: a quite independent task of arrangement and statics. However, the ape's treatment of ladders brings out two points not conspicuous in the problem of the boxes.

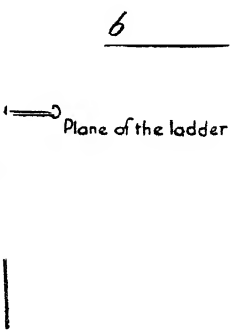

FIG 11.

When Sultan first made use of the ladder (instead of a box or a table, see p. 48 above) his handling of it looked very strange. Instead of leaning it against the wall near which the fruit was hanging from the roof, he set it up in the open space directly under the objective in a vertical position, and tried to climb up it. If the observer is already acquainted with the animal's habits, he will at once realize that the ladder is here used as a *jumping-stick*. The chimpanzee tries to use this long wooden frame in the same way as sticks and planks. As this method meets with no result, it is altered. Sultan leans the ladder against the neighbouring wall *a* (cf. Fig. 11), but quite differently from the way we do, so that one of the uprights rests against the wall, the plane of the ladder extending into the room. He then ascends the ladder. As the objective is hung from the roof close to one of the corners of the room, and the animal in mounting the ladder has the other wall *b* close before him, he succeeds on the lower rungs in preserving both the ladder's equilibrium and his own, by

resting one arm against the wall *b*. But before he reaches the prize, the ladder falls, and after Sultan has had several such tumbles, he lies still for a while in annoyance. Then he returns to the task, and after long trying, finds a position more similar to that in human use in which he succeeds in climbing the ladder and securing the prize. But in this case, as in the previous efforts, he gives the impression of not aiming at placing the ladder against the wall in a human fashion, but, as far as possible, *fitting it to the wall*, while remaining more or less under the objective. The first tendency is the more pronounced and sometimes predominates entirely: therefore, even when the ladder is successfully used, it stands much *too vertically* for our human requirements of statics.

Grande, the exceedingly indifferent acrobat, did not care to do pole-jumping, and so her use of the ladder on the first occasion differed entirely from Sultan's. She had not been present at his test. (Date: February 3rd.) The objective was again suspended from the roof near a corner of the room. Grande brought the ladder to the spot, laid it horizontally against the wall (edgeways up) and tried to reach the objective by jumping from the upright that lay topmost. She had only recently been inititated into the use of boxes; in the absence of such an article, it is easy to see that she places and uses the ladder as a sort of *defective box*, that has to be propped against the wall. But in the next experiment she lifts up the ladder as Sultan did, in such a way that one upright is propped against the wall and the rungs protrude vertically from it into space. The end of the upright got just enough support against the rough wall to keep it in position, but as Grande began her ascent, it slipped of course and so did she. Nevertheless she often repeated the effort, keeping to the same position of the ladder, until at last and purely by chance, the upright was caught and supported by a little roughness in the wall, long

enough for her to climb up (the ladder almost in the air, to our notions) and reach the goal. I repeated this test with Grande three months later (May 14th). She set up the ladder in almost exactly the same position as before, only at a slightly less vertical angle. The caution and dexterity with which she balanced the swaying of the ladder, by movements of her own body, were wonderful and admirable, for as before, the ladder was precariously supported by the end of one upright only, and the whole proceeding looked almost super-static.

Sultan kept to this procedure till 1916. As Chica also prefers this position (and but rarely presses the flat side of the ladder against the wall) this manner of placing it can hardly be mere coincidence. Equally it will be no coincidence that the normal, human method of placing a ladder in position was never perfectly carried out—i.e. unmistakably and at once, as a real solution.

The resulting conclusions may be summarized thus :

1. If we exclude Sultan's attempt to use the ladder as a jumping-stick, we must admit, from the other efforts, that chimpanzees do possess a very modest understanding of statics, and that we can only speak of an *almost* absolute lack of insight in this respect. Both Grande and Chica press a box that is too low, sideways against the wall ; they do not try to suspend it *in vacuo*. Sultan, Grande, and Chica try to put the ladder into contact with the wall, as soon as they perceive the need for firmness, but at first contact is purely *visual* ; and, therefore, not much depends on whether, in their subsequent attempts, an *actual* and practically useful contact is established as well, as long as the ladder will somehow stick to the wall. Even in their procedure with the jumping-stick the same point could be noticed : none of the animals tried to hold too short a stick or a second one, added for length (compare Rana, p. 124 seqq.)—simply higher up *in the air* ; the end must be in touch with something or,

at least, appear to be in optical contact. Thus the dangerous venture of Chica in putting the end of her pole on the narrow edge of the open box showed not only lack of clearness in statics, but also, by the very minute attention and precision with which she placed the pole just there, and not blindly *in the air*, a plain static need.

But the pressing of the boxes against the vertical wall proved again that this need has not evolved much beyond visual and physical contact. The placing of the ladder has certainly been decided by the urge to bring about visual contiguity between ladder and wall, and therefore is not the outcome of mere trying around; but since only this visual factor comes into consideration, the procedure remains odd to our eyes. The ladder which is in contact with the wall by the length of one upright, or by the whole face of the rungs, is *optically in closer contact* than if it were supported at four points—the two extremities of each upright—as in our human fashion. It is then statically rightly placed, but probably appears to the chimpanzee to be "not firm", just as *his* favourite position does to *us*. Unfortunately this visual factor, too, is never fully evolved: in box-piling there is no attempt at a real fitting of forms, and even "rough contact" is ignored to some extent when, for example, boxes project considerably beyond their pedestals. There is probably, in problems in which full insight will not in any case be attained, a tendency to neglect even the possible degree, and so the ape merely "tries around." In the case of the ladder the task is a little easier: the relation "homogeneous wall—simple total shape of the ladder" is more easily comprehensible to an ape than the relation of two boxes. Here, a certain statics of contact is quite indisputable, though it varies from human ideas and is very "unpractical." The particular position of the ladder with one upright against the wall and the rungs projecting vertically into space is

probably determined by the *position of the fruit.* Had the first tests in this series been arranged with the objective attached to the wall, pressing the rungs of the ladder to the wall would perhaps have been the only procedure adopted.[1]

[As this essay treats as little as possible of theory, I will give only a brief suggestion of the manner in which the habits of the chimpanzee positively hinder the evolution of statics. We know[2] that in human beings the absolute visual orientation in space which makes complete reversal of forms appear as a strong alteration, develops gradually in children. The hypothesis that this (normal) *absolute spatial orientation,*[3] this fixed " above " and " below," is a product of the *habitual* upright posture of our heads, appears plausible, whether we wish to attribute the formation of these facts to " experience ", or (like the author) are inclined to admit a direct physiological influence of gravity upon the optical processes in certain parts of the working nervous system (as in this upright posture). In any case, we should not have developed *this absolute orientation in space* to such an extent, if we, like the chimpanzees held our heads just as often in other positions as vertically erect. If we consider the fundamental dependence of our statics on the generally firm orientation of " above " and " below ", the " vertical " and " horizontal " (a child too has no statics as long as it lacks this absolute orientation), it will be evident that the chimpanzee lives under very unfavourable circumstances to the development of statics.

On the other hand, his natural life is eminently calculated to exercise the functions of the labyrinth and cerebellum, and to make him so muscularly dexterous and agile that the least expert acrobat among chimpanzees need not fear human rivalry. Thus in the manipulations with ladders and boxes,

[1] Subsequent tests about this point gave no definite results

[2] W Stern, *Zeitschrift fur angewandte Psychologie,* 1909; F. Oetjen, *Zeitschr f Psychol.,* vol 71, 1915.

[3] M Wertheimer. *Zeitschr. f. Psychol.,* vol 61, p 93 seqq.

he lacks a powerful incentive to the development of statics, for he is physically able to cope with structures to which no human adult would trust himself.]

2. When an inexperienced observer comes into contact with the chimpanzees and wishes to test them in any way, his method is, very often, to give them carefully designed and specialized human implements, e.g. ladders, hammers, tongs, etc., and to inquire whether they utilize these. And then, if such an inexperienced observer sees a chimpanzee using a ladder, he is amazed at the high degree of intelligence and development displayed. But we must quite distinctly understand that the chimpanzee is *not using a "ladder" in the human sense* of the term (which connotes both a special *orm* and a special *function*), and that, for the ape, a ladder has no particular advantages over a strong plank, a pole, or a tree-trunk, all of which he utilizes in much the same way,[1] for he only apprehends the rough qualities of the whole object and its most primitive functions.

But the observer is far less impressed by the utilization of tree-trunk, pole, or plank, just because he was dazzled and misled by the *external* "humanness" of the chimpanzee's employment, of a "real ladder", though the trunk, pole, and plank are, for the chimpanzee, absolutely equivalent to the ladder. We must be very careful in this case, as always in investigating the ape's nature, *to distinguish between the external impression of humanness—possibly only due to the instrument used—and the degree of insight and the level of achievement displayed.* The two are not, by any means, necessarily parallel. I must explicitly state, in order to dispel any misconceptions, that I do not recognize any differ-

[1] This, although he certainly *sees them as "different things"* and, as this whole book proves, does not simply pass through diffuse streams of phenomena (Volkelt, *Vorstellungen der Tiere* (1914)—where lower forms of animal life are considered) I admit that the objects perceived by the chimpanzee have not all the qualities of *our* objects.

ence in value between the employment of a ladder and of a jumping-stick by the chimpanzees; and I consider that there is only a minute difference in that respect between the placing of a ladder *under the objective*, and the same procedure with a strong plank. Ladder and board are both utilized in the same manner and are *practically the same* to the chimpanzee, as he grips with his feet. For us humans, they are quite different, and while the chimpanzee's jumping-stick would be a wretched implement for most human beings, it is even more convenient for the chimpanzee than the ladder. External resemblance to human procedure is no criterion here.

We must always first consider the *function* of the tool, the purpose and manner in which it is used *by the chimpanzee*; we must analyse and determine what qualities and properties he *realizes*. And, having learnt the *range of functions*, within whose limits the chimpanzee is able to understand the utility of any object, we shall prefer to investigate his achievements and methods of arriving at his solutions in this clear and simple domain, instead of bringing him into contact with the complex products of human craftsmanship. For in such products—e.g. even in ladders, hammers, tongs—there are combined a great number of delicate functional points of view. The ape will always leave uncomprehended and unrecognized full half of what, to us, are the essential requisites in such a tool. He will make, on the one hand, an impression of dullness or confusion, because he uses the tool wrongly, and, on the other, he will look imposingly "human", just because he "handles ladders, hammers, and tongs." The experimental tests furnish clearer and more valuable results, both for the estimate of the chimpanzee's stage of development and for the psychological theories one wishes to base on such research, if we do not employ as "material" the complicated tools of human invention, but confine ourselves to the most primitive objects—primitive both as regards form and function.

Otherwise we only confuse both the animals and ourselves as observers. Only as long as the region of simple intelligent treatment of the surroundings is not even superficially investigated, can one fail to see that we must study the simplest functions which can be grasped with insight, before the animals are overwhelmed with whole conglomerations of problems at once.

The position is somewhat different in respect of another class of problems: when there is no longer a question of discovering what the chimpanzee is able to achieve by his unaided efforts. When once we are to some extent in a position to judge this, we can pass on to further tests with more intricate conditions and material, in which we offer him all possible teaching and assistance, in order to see how far he learns to understand. We human beings, too, did not discover all the methods of acting intelligently in a day, but learnt much by the aid of instruction. And so it would be a significant problem to solve, whether the chimpanzee could learn to comprehend the human use of the ladder, or whether eventually he could —with human help—realize the essential function of a pair of tongs.

Supplement: Building in Common.

After the chimpanzees available in our researches were already familiar with the process of piling one box on another, the whole group was often afforded opportunity to build up boxes towards an objective suspended at a considerable height in the playground. In time this became a favourite amusement. But we must not suppose that this " co-operative building " represents any systematic collaboration, with any strict division of labour among individuals. This is, rather, the procedure: The objective is hung in position, and the assembled chimpanzees gaze around for material to use as tools. In a minute they have all rushed under it, one with a pole, another armed with a box; sometimes they drag their

tool along the ground, but Chica prefers to lift her box up in her arms or to balance her plank on her shoulder like a workman. Then several of the animals want to ascend at the same time, each behaves as if he alone were about to " build ", or had himself erected any " pediment " that may exist, and wished to complete the structure quite unaided. If one ape has already begun this constructional exercise, with others building close beside him, as frequently happens, a box is unhesitatingly pilfered from the neighbour's store and the rival architects come to blows ; this is apt to interrupt the progress of the work, as the higher the structure, the keener the competition to mount it. The result is generally that the object of the struggle is itself destroyed in the struggle —knocked over in the mêlée. So the apes have to start again from the beginning, and thus Chica, Rana, and Sultan often give up the labour and struggle, while Grande, the oldest, strongest, and most patient of the four, is left to complete it. In this way she has gradually acquired the most skill in building, although the more impatient animals, Chica and Sultan, are distinctly superior to her in intelligence.

It is only rarely that one animal *helps* another, and when this happens, we must carefully consider the meaning of such action. As Sultan was much more expert than the others, in the beginning, he was often obliged to be present without helping, as I wished to ascertain the capabilities of the others. In one of the illustrations (Plate IV) we may observe his attentive interest. (He is below, on the right-hand side of the picture.) If the observer's vigilance is at all relaxed, and the veto on building not continuously renewed, Sultan does not venture to enter fully into the work, but he cannot keep from " lending a hand " here and there, supporting a box that threatens to fall under some adventurous and decisive effort of another animal, or otherwise taking a less important part in the work. (Compare Plate VII, which is a reproduc-

tion from a cinematograph film: Sultan is steadying the box, which moves under Grande's weight.) On one occasion when we had forbidden him to participate in the building, he could not keep to the rôle of passive spectator, when Grande had piled one box on the other, and was still unable to reach the prize. He quickly fetched a third box from a distance of about twelve metres and put it close to the pile; *then he squatted down again and watched,* although he had not been reminded of my prohibition by either word or gesture[1]. But we must guard against misconceptions: Sultan's motive is not the wish to help his fellow, at least not predominantly. When we watch him, squatting beside the other animal, following all Grande's movements with his eyes and often with slight sketchy movements of arm and hand, there can be no doubt that these proceedings *in themselves interest him,* and to a very high degree; that he follows and "feels" the movements himself, and all the more keenly as they grow more difficult and crucial. The "help" he offers at the critical moment is simply *a heightening of his already indicated participation in the process*; and interest in the other animal can play only a very secondary part, for Sultan is a pronounced egoist. In the second part of this work I hope to show the extent of this "participation", and the compelling urge that seems to overwhelm the chimpanzee who is a spectator. (Cf. on Plate VII, in the foreground: the animated gestures of Konsul at the critical moment: on the cinema film this is, of course, much more graphic.) We are all acquainted with similar states of mind. It is difficult for anyone who, as a result of long practice understands any form of work, to stand aside while another bungles it: his fingers itch to intervene and "do the job". And we human

[1] I have already said what is necessary on the subject of "reading into" and "anthropomorphism". There was no ambiguity whatever in Sultan's behaviour on this occasion.

beings, too, are far from wishing to help such a bungler from motives of pure altruism (our feelings towards him at the moment are not particularly cordial). Neither do we seek some external advantage for ourselves : *the work* attracts and dominates us. Sometimes I think that in these traits of character the chimpanzee resembles us even more closely than in the realm of intelligence in the narrower sense ;— but we should be on our guard against a mere *intellectualist* interpretation of them. (A fine example of this resemblance in minor traits is the habit of " passing on " a punishment that has been suffered to an habitually unpopular or uncongenial animal : Sultan often does this to Chica.)

Sometimes the behaviour of the animals strongly resembles collaboration in the strictly human sense, without, however, entirely carrying conviction. (Date : 15th February.) The little ones had made repeated efforts to reach an elevated objective, without success. At some distance stood a heavy cage, which had never before been used in the tests. Suddenly Grande's attention was caught by this cage ; she shook it to and fro, to turn it over and roll it towards the objective, but could not move it. Rana forthwith came up, and laid hold of the cage in the most adequate way, and the two were in the act of lifting and rolling it, when Sultan joined them and, seizing one side of the cage, " helped " with great energy. Alone, none of the three could have stirred the cage from its place, but under their united efforts—which were " timed " together perfectly—it rapidly approached the goal. It was still at a little distance when Sultan bounded upon it and then, with a second spring, secured and tore down the fruit. The others received no reward, but then, they had worked for themselves and not for Sultan, who had good reason to take a sudden dash forward, for otherwise he might have been " done out of it.". Rana certainly understood Grande's intentions when she first began to move the distant cage, and

took a hand in her own interests just as Sultan did. As all three had the same aim, and as the moving cage prescribed to all of them the form of procedure, the box was rapidly rolled on its way.

The following examples are pendants to Sultan's behaviour when he saw others building and was excluded from the competition. As he is, generally speaking, much in advance of the other animals, he is sometimes permitted to be present when they are undergoing tests with which he is already familiar. He pays close attention—as in the building experiments—but is not allowed to take part. If the test is one in which the animal under observation is on the opposite side of a grating—for Sultan watches from *outside* the bars—and the objective is outside on the ground, no stick being available, Sultan watches the other animal's ill-adapted efforts quietly for a time. Then he disappears, to return with a stick in his hand. With this stick he scrapes sand together, at a distance from the objective, but near the bars, or pokes through the bars. If the other ape tries to grasp it, he pulls it away seemingly to tease, and thus there develops a to and fro game, *which tends to leave the stick in the neophyte's hand, if no prohibition on my part intervenes.*

In one of these tests the neophyte could have supplied himself with a stick by breaking up the lid of a box which stood near the bars. Sultan was sitting outside, but the other chimpanzee failed to solve the problem. Suddenly Sultan began to shuffle towards the bars, until he was quite close to them. He cast a few cautious glances at the observer, stretched his hand between the bars, and tore a loose board from the lid. The further course of this test was an exact repetition of the one just described.

In both cases, as in the building examples, Sultan's behaviour shows no trace of "altruism", but, though he takes no part in the procedure, we feel his complete comprehension

of it, and his imperative impulse to *do something* towards the solution which remains so long undiscovered.

It is clearly proved by the following instance that he really sees the task to be carried out, *from the standpoint of the other animal.* I was endeavouring to teach Chica the use of the double stick. I stood outside the bars, Sultan squatted at my side, and gazed seriously, slowly scratching his head meanwhile. As Chica absolutely failed to realize what was required, I finally gave the two sticks to Sultan, in the hope that he would make things clear. He took the sticks, fitted one into the other, and did not himself appropriate the fruit, but pushed it, in a leisurely manner, towards Chica at the bars. (Had he been very hungry, his behaviour would probably have been quite different.)

Mutual obstruction is more frequent than co-operation. Tercera and Konsul do not take part in the building operations; they sit on some point of vantage, and watch the others at work. But when the building is in full swing, they give striking proof of their comprehension. They love to creep up behind the back of the busy architect, especially when he is perched precariously high, and, with one vigorous push, knock both building and constructor to the ground. They then flee at top speed. Konsul was a master of this game as well as of every grotesque contortion. With an expression of comic rage, stamping, rolling his eyes and gesticulating, he prepared his fell design behind the innocent constructor. It is impossible to describe happenings of this sort; I have seen observers shed tears of helpless mirth as they watched them.

The emotional foundation of this behaviour is a little difficult to understand; in that described below it seems clearer and also has been frequently observed. One of the animals has just completed his building; then suddenly another, the redoubtable Grande for instance, approaches, with unmis-

takable intent to use the first animal's efforts for her own advantage A pitched battle seems inadvisable, but the smaller animal does not at once take to flight, leaving the field clear. Instead, he sits on the edge of the topmost box and slides off it in such a way that the whole structure overbalances and collapses. This proceeding differs totally from that usually adopted in descending and must be intentional; flight follows and rage on the part of the outwitted aggressor.[1]

[1] A Sokolowsky made observations on a number of anthropoids in Hagenbeck's Zoological Park I find that other investigators cast doubts on some of the achievements of the apes as recorded by him. It is certainly true that an expert psychologist would choose his expressions in the description of the subject more carefully, and show more reserve in his comments But, after my investigations so far, I find the bulk of the facts recorded quite probable, and he correctly recognizes that under certain circumstances anthropoids act with insight And let us not forget that Sokolowsky was the first person to suggest the psychological study of anthropoids on an experimental basis, in special institutions on account of the deficiencies of all occasional observation.