

Proceeding from the significance of speech for thinking, some investigators have sought for the seat of logical thinking and abstract reasoning in these and the surrounding parts of the frontal brains. It appeared, however, that the loss of speech did not effect the capacity for thinking: "... the functioning of the "intellect does not depend on normal conditions of the cortical "motor organ of language... but on its cortical sensory organs, "auditory and visual..."; "the motor area of language does "not exercise any real regulative power on either the formation "or on the movement of thought." It is "the auditory sphere of "language, which is one of the main wheels in the logical "movement of thought." (Bianchi, l.c. p. 119—120). The parts of the cortex in which the connection of wordsounds with corresponding thought-series takes place and forms itself, are the association-fields, situated round the temple lobe. When these fields are affected and destroyed by disease, the symptoms of word-deafness and word-blindness appear. The sound is then heard, or the word read, but its meaning is not understood, and the whole process of logical thought, the normal linking of conceptions, is disturbed. From this must be concluded that the heard word is far more closely connected with human thinking than the spoken word. Yet we have to consider that both these functions do not exist independently of each other, but, localized in neighbouring fields of the cortex, influence each other powerfully. This is apparent, for instance, in that such mental defects are nearly always connected with the very hemisphere that contains the speech-centre becoming affected. The one-sidedness of the active speech-centre clearly involves an asymmetry in the organ of hearing and comprehending. The anatomical substratum for the connections of speech and thought must be sought for in the countless connections in the fields of association and assimilation alongside and around the sensorial and motor centres, which constitute the huge main part of the human cerebral cortex.

VII. TOOLS AND THINKING

27. We read in Aristotle: "Anaxagoras says that man is the "most intelligent animal, because he possesses hands". Thus the realization of a deep natural connection between the spiritual

and the material world already appears in the first philosophical thoughts of antiquity. Later ages receded from this opinion; Aristotle quotes him to reprove him, and here Galen agrees: "Because he was the wisest, he therefore possesses hands, as "Aristotle rightly judged. Because not the hands taught man the "arts, but reason". And also Charles Bell, in accordance with the aim and the purport of his book, holds with this opinion: "the possession of the ready instrument is not the cause of "man's superiority... So, we rather say with Galen, that man "has hands given to him, because he is the wisest of creatures, "than ascribe this superiority and knowledge to the use of his "hands." (Bell, p. 249).

This "use of his hands" is the using of tools. It has been repeatedly stated that the use of tools and human thinking are not independent of each other. Above, in chapter II, attention has already been drawn to the fact that intelligence, *i.e.* human thought, is required for using and even more for making and inventing implements. For it demands the capacity of reviewing beforehand and imagining the results of what does not yet exist, or rather only exists in the mind.

This connection of course cannot mean that human thought at first spontaneously came into existence, by means of the biological growth of the brains, and that after that tools were invented and handled. Such an opinion overlooks the fact that human thought, compared with animal thought, not only shows a quantitative increase, but also a qualitative change of character. Its coming into existence of its own accord would be a miraculous creation, lying beyond the province of science. Moreover the infinitely slow development of the first stone implements over a period of thousands of centuries contradicts such an opinion; it displays all the features of a laborious growth on its own accord, hence an autonomous development, which is totally different from what an even slowly growing deliberate reasoning would have invented. Intellect is not a given capacity that previously existed in a dormant state; it consists of thoughts, which form and change according to the stimuli and necessities of life. It is well-known how, from a study of later ages which were more highly developed technically, technical imperfections, as experienced in the practical use of tools, had a stimulating

effect on the faculty of thinking. The very fact that human reason is needed for using tools, means that thought had to take on such forms as suited and made possible the use of tools. Thus, conversely, the handling of implements acted on thinking.

28. To realize the influence of the implement on thought, we must, as if condensing a long gradual development into a sudden jump, compare the actions of an animal or of man's tool-less ancestor, and those of a primitive man already possessing tools. When faced with the recurring conditions of its environment, such as hunger and food, prey, or danger, the animal's reactions, which may be attack, defence or flight, are dictated by its bodily organs, thereby becoming lifetime habits. Even if the animal should have a more developed faculty of thinking and could imagine other reactions, this would still be of no use to it; its bodily build restricts its possibilities. Hence its thinking and its brain-apparatus are and remain just what they are. Its reactions have become fixed along almost stable tracks into permanent habits, taking place as immediate instinctive actions.

Man's reactions to exterior stimuli are of a different nature, as in between his body and the exterior world on which he must react, the tool enters. Instead of immediately using his bodily organs, by seizing his food between his jaws, gripping the prey with his hands, defending himself with his fists, or fleeing from danger, he takes the appropriate tool or weapon and uses it. With it, as if he were a new being, equipped with a new organ, he manipulates his food, or attacks his prey or enemy. His actions follow a new course; hence his thoughts too have to follow a new course. The actions follow a detour, no longer going directly to the object, but to the implement, and only then from there to the object. Therefore thinking must also follow a detour. The spontaneous impulse to act, belonging to the condition in which there were no implements, has to be restrained; consequently the immediately formed series of perceptions of springing to action or fleeing must also be suppressed and be replaced by another leading to the implement or the weapon. Thus one characteristic element of human thinking, its indirectness, already noted above, appears as a necessary consequence of the use of tools.

The former consecutive series of actions, from the first perception to the attained object, is now interrupted halfway. The implement must be taken, fetched or made ready. All this means a postponement, with a continuing and completing of the action coming about only later on. Therefore the corresponding series of perceptions too is arrested, to be taken up independently later on. Or more precisely, the series of further connected perceptions is formed, but without the accompanying act, existing merely as thought. The process of thinking takes on a new form. It becomes an act in itself and finds an end in itself, *viz* in an intention or an inference or a suspended plan; it remains spiritual, not producing an actual phenomenon. In this way the use of tools leads to independence of thinking; it is no longer part of a process but a separate process itself. The separation of thought and action, which we learned to recognize as the essential characteristic of human mental activity, manifested in the separation of theory and practice, is induced by the fact that the tool places itself as a new element between the organism and the exterior world.

The chain of brain-processes, therefore, must also change. The cerebral cortex after the same stimulus of the sense-organ must effect a different motor reaction. The stimulus may no longer pass in the former way from the sensory to the motor centres; new connections have to be formed for new co-ordinations with other cortex-fields. Nerve-fibres will have to develop in a new way. The stimulus must follow another route, link itself with memory-images of the implement or weapon, and along this new detour affect the motor centres. At the same time the former course must be checked, and the old connection must be put out of action, — though in cases of panic it momentarily acts again —, and also the result of the new co-ordinations must often be suspended, and hence arrested. What Judson Herrick states of the cortex generally, — “primitively, cortical activity is invoked, not to produce action, but within action, “first checking inappropriate reflexes and then amplifying, “redirecting, recombining, or otherwise improving upon the “immediate responses” (23, p. 260) — is applicable here too on a higher level. Whilst the old course *a—b* becomes atrophied,

by being constantly arrested and by disuse, the new indirect routes $a-c-b$ continue to develop by constant use.

Now man does not have just one tool at his disposal, but different ones, so that he must choose between them. At every sensual perception, whether of food, danger, or a prey, he must not only suppress the old impulse, but also make a choice, and decide which implement he will use, and how to act with it. The implements now become objects which have to be inserted as separate interchangeable links into the series of actions; therefore the conceptions too, as their correlates, become separate mental objects, which must be inserted as interchangeable links into the series of perceptions. The series of perceptions must not only extend to the tool, but proceed to the final action, and again not only for one, but for each of the available implements. It has been said above (in chapter III, § 11) that the series of perceptions continues as if by itself, even though the action may be arrested. It is now apparent why this series must be continued till the end: because the intervention of the implement was the cause of this arrest and this arrest gave rise to a choice. All these series of perceptions must be followed and their results compared, the entire row of possibilities must be considered, and the decision and action take place according to be findings of the result. Where formerly different series of possible actions were spoken of, it now appears that this diversity has its origin in the diversity of implements that can be used.

The stimulus-current now does not follow one single detour in the cerebral cortex, but several; there is not one $a-c-b$, but an $a-c_1-b$, an $a-c_2-b$, etc. The nerve routes c_1, c_2, \dots corresponding to different series of perceptions, singly and still more when combined, form such an extensive complex that a much greater and more intricate profusion of connections with each other and with the sensory and motor areas must come into action and be developed in the relevant extensive fields of the cortex. In the mutual comparison of the routes the function of attention comes into action, whereby active consciousness of thoughts and actions is established. And according as the implements become more widely differentiated and life's possibilities ever more varied, the connections of the

nerve-tracks must become more intricate, the association-tracks must grow into an ever more important part of the central organ, and thinking must develop into a faculty of increasingly greater wealth and independence.

A choice had already to be made before implements were constructed, when man only took in his hand the crude stones and sticks offered by nature. It is possible that then the first dawning of conscious reflection might already have appeared. However, the independence of the process of thinking is only achieved when foresight of the action leads to preparation in advance, hence, when man makes his implements. The further action, involving the use of the implement, must have been thought out in advance, and in consequence prepared for in anticipation, before the needs of the situation or the event caused action to be taken. At this stage the action is divided into two entirely separate parts, each complete in itself. The first is the construction of the implement, as a preparation, which is an independent and for the moment concluded act. Hence at this stage, thinking too must build up its chain of perceptions independently, autonomously, starting from itself apparently without a direct exterior impulse, and fed by the memory-images of former experience. Thus, from the necessity of constructing the implement in advance, a world of thought develops which is man's own mental life, a theoretical compendium of all his experiences, and a source for all his further conscious action.

29. In this way the tool gave a powerful impetus to the development of human thinking from the mental processes of our animal-like ancestors. No one has disclosed the significance of the tool with such a force of conviction as the German scientist Ludwig Noiré in his above quoted book: "*Das Werkzeug und seine Bedeutung für die Entwicklungsgeschichte der Menschheit*" (1880) (The Tool and its Significance for the Development of Mankind). Here he writes: "No moment has been of such a vast "and incalculable importance for the development and fixing of "thinking as the circumstance that soulless matter took on a "definite shape and, formed and transformed by the hand of "man, had to serve purposes and to perform labour which all

"other beings are only able to perform with their innate organs. Its great importance is chiefly situated in two things: firstly "in the release or detachment of the causal relation, whereby "the latter acquires a great and increasing clarity in human "consciousness; and secondly in the objectivation or the projec- "tion of the own organs whose action originally existed only in "the dimmer consciousness of instinctive functioning." (p. 34). Formerly the causally operative effects of nature are undergone passively; and also when the animal acts actively, its acting is a natural impulse which does not give rise to amazement and, therefore, to thought. "The relation becomes entirely different "when the tool places itself as an interjacent link between the "will and the intended result. . . . For here the causal conception "strikes the eye and imposes itself as if of its own accord. The "working object must first be created or at least fetched; the "relation between the appropriate means and the intended "action is precisely the causal relation itself; here it presents "itself to the observing consideration in its simplest tangible "embodiment." (l.c. p. 35). That consciousness acknowledges itself as an effective force, as a cause, and thus becomes self-consciousness in objective contemplation of itself, is rendered possible only when in tool and machine the working cause and the resulting effect stand clearly before one's eyes. Therefore, too, the organs of the human and animal body are only understood in their action after the creation of artificial implements and apparatus which can serve as comparative examples. The arm is then explained and understood as a lever, the eye as a camera, the ear as a keyboard, the heart as a pump, the larynx as an organ-pipe, and the nerve system as a telephone network.

For man equipped with implements the world becomes an object, or rather a multitude of objects, on which he reacts in various ways, whereas for the tool-less animal the world remains a whole in which as a part it finds its place and performs its actions of life. "The consciousness of self kindles and illuminates "itself only from the objective world; but not from the objective "world as such, as it surrounds us and stares at us, as indeed "it is also stared at, i.e. looked at without understanding, by the "animals, but in so far it is changed, modified, transformed by

"human will, by human activity, i.e. by the subjective factor" (l.c. p. 61).

30. A new and powerful influence emanates from the handling of tools to the organs of perception and consciousness, and thereby to mental life. It supplies a new experience of the exterior world. The delicate sense of touch vested in the fingers comes into action when gripping and guiding the tool which is used to operate on the outside world by some such action as beating, pressing, rubbing and boring. It is an aggressive operation, attempting to bring about changes. The exterior world reacts, and its resistance, which must be broken, is caught up by the hand as the organ of the sense of touch. Since intensity is felt and measured here, this is quite another use of the sense of touch, as it is different from only contacting the surrounding space for the purpose of orientation (a use which, in fact, hardly plays any part at all with adults). "The high importance of the "hand as an organ of reason lies in its preponderant activity, "that essentially necessary factor, without which no knowledge "at all becomes possible." (Noiré, p. 96). /d

The experience of the use of tools, as an active expression of a vital energy, called up by life's needs, speaks much more intensely and more penetratingly than the passive experience of the impressions of the other senses. As also experimenting, the provoking of answers from the world in reply to our questions, although indeed a much softer way of operating than labour for the needs of life, does work more intensely than mere expectant observing. Apart from the sense of touch, the muscular sense comes into action which, through the innumerable retroceding nerve-fibres, informs the organism about its own movements. In the muscular exertion when working with the tool, such as in the blow of the axe or hammer, where the momentum of the moving arm is increased by the handle, the relation between the observed effect of living force and the feeling of accurately balanced applied energy offers a rich source of new experiences of the world.

31. The precise manner in which the tool affects thought, technique affects science, and *vice versa*, is clearly seen in the

later and modern development of man. This is, however, more difficult if we go back to primitive times, as no data of experience are available. We may then try to understand these relationships, as explained above, by comparing Early Man possessing implements with the animal not possessing them, by comparing Early Man already equipped with the capacity of thinking with the conceptionless animal, and then to compare their reactions. In actual fact, however, it was an extremely slow development and a process stretching over many hundreds, perhaps thousands, of centuries, in which the infinitely small steps are not visible and cannot even be imagined. Is it not possible to fill in this lack of data by bringing the most highly developed animals, the anthropoids who in their brain capacity most of all approach man, into contact with simple implements, and to study their reactions?

Here it is not a matter of apes using such human utensils as a spoon, fork and mug, which is nothing more than a sign of teachability and a greater faculty of imitation than in the case of other animals; and it has still less to do with the fancy that their intelligence could be developed to a higher stage through the use of implements. The real significance of such tests lies in a careful and scientific investigation being made of the mental properties and abilities of these animals, as was expressed by one of the pioneers in this realm of research, Wolfgang Köhler, in the title of his book "*Intelligenzprüfungen an Menschenaffen*" (Intelligence tests with anthropoids). Here the anthropoids are given simple aids, such as boxes, sticks, pieces of rope and cloth, by which they might obtain the coveted fruits set beyond their reach, to see how they would use them. The animals used were always the chimpanzees, for although gorillas are usually placed above them with respect to their brain capacity, the chimpanzee nevertheless shows a more active intelligence, which is probably due to a more active group-life.

The chief difficulty lies in the interpreting, even in merely describing the results of these tests, because the terms used are always taken from the human spiritual life. The title of the book by the American psychologist Yerkes: "Almost Human", reveals a tendency, in the background of thought, to show how much of human thinking is already to be found with the chimpanzee.

And even Köhler, with his judicious, well-balanced conclusions, now and then includes judgments inserted into the descriptions of a test: "there now, Sultan makes a 'bad turn' or more 'precisely a shocking stupidity.... Immediately afterwards 'comes an action that may be reckoned among the good 'errors....' (l.c. p. 90); as if the animal during an examination had to attain to a certain standard, the norm of which was adopted from human thinking. Yerkes states "they have ideas" which can mean much or little, and in his standard work "The Great Apes" he successively discusses the "memory", the "imagination" and the "indications of abstraction and generalization". These however are not specific features of human spiritual life. It can be said that each animal generalizes, in that his memory-images are made up of summaries produced by all former and similar experiences. The meaning of his expression "ideational conduct" is that the act is not dominated only by the immediately preceding sense perception. The problem, however, is to what extent, and especially how, considering the resultant actions, different former experiences are assimilated in the perceptions.

What strikes the observer most of all is that, especially after fruitless attempts to get the banana, the animal quietly sits down and "thinks", and then jumps up to make a new attempt. "The problem is solved, not by fumbling, but by what Köhler 'calls 'insight'. We need not assume that Köhler's chimpanzee "reasoned the thing out and formulated his conclusions in "logical syllogisms. The average man would not solve the "problem that way either. When a man confronted with a "simple problem like this does 'stop to think', the right way to "do it may come to him all at once in a flash of understanding. "He 'sees through' the situation before he makes a move. In the "case of the man his previous experience includes many situations each of which has something in common with the present "problem...." — thus Judson Herrick represents this behaviour (24, p. 225). It should be noted here that logical syllogisms undoubtedly play their part in the case of man, including the savage, even though in simple every day problems they are not thought of in these scholarly terms. In the cases of both man and ape the deposit of former situations emerges and

comes to the fore in the expectant sitting still; and this then determines the action. It does, however, differ in character; with the one it is a simple memory-picture, and with the other an argument clothed in words. By calling both "ideas" their essential character is left uncertain. In the case of the younger animals the stick is used to help get the banana, if both are seen simultaneously; if the animal only sees them in turn, it does not dawn upon him to associate them. The older and more experienced animals however, who have learned a great deal through the experiments, remember the stick and at once go and fetch it or look for it.

An attentive study of the experiences as described by Köhler confirms the thesis that animals are incapable of seeing separately the various parts of a nature-impression in such a manner that they can imagine them in another position and in another context, because they lack the conception and therefore also the perception of separate things; for that reason they cannot use them as tools. At the same time, however, we discern circumstances where this truth begins to find its limits. The highest achievement of these chimpanzees appears to be something which, in spite of Franklin's definition, might be called "tool-making ability". One animal had two bamboo sticks, a thick one and a thin one, both too short with which to reach the bananas beyond the fence. Having worked unsuccessfully with these and other things, it happened that finally, after the observer had left and only the keeper was present, the animal held a stick in each of its hands, playing with them in an indifferent manner. "There it happened that it held out a stick "in each hand, and in such a manner that they lay in one line; it "placed the thin one a little way into the opening of the thick "one, and at once jumped up to the fence, to which it had at "first turned its back, and began to draw the banana towards "itself with the aid of this double stick" (l.c. p. 91). So, by accidentally placing the sticks in this manner, it saw a longer stick there; it now knew the trick, and when the sticks fell apart, applied the new knowledge again and again. Even more striking was the case with one of the other apes, in whose cage there was a shrub with branches, which it had tried in vain to pass through the bars in order to reach the banana. Afterwards,

H+ H things by ever new experiences, just as rats and fishes can also

when sitting quietly and looking at the shrub, it suddenly jumped up, went to the shrub, broke off a branch, and made use of it for its purpose. Apparently while looking at it, its attention was drawn so intensely to the branch, that the animal saw it as a separate entity, similar to the sticks it had previously used. More intelligent types at once broke off the branches; perhaps this breaking off of a branch is something that they knew from their state of nature.

Though such experiments are highly important for obtaining a correct insight into the spiritual processes which take place in the highest apes, and though they can teach us something about the dawning reactions of pre-human thinking to the use of implements, yet they have only an indirect significance for the problem of the origin of man. The conditions existing during these investigations and those during the first origin of man differ too much. Here, the animal, the experimental object of the higher intelligence of man, is provided by human design and deliberation with ready made implements thought out for him. There, Early Man's ancestor had in an infinitely slow process to seek for himself the first aids in his heavy struggle for life. Here, the ape is studied as it is now, and how his mind works now. Even though the animal learns all kinds of individual ~~thing was just the slow change of the species itself, the develop-~~ learn all kinds of things through training, there is of course no question of a development of the species to new properties in these short, or even much longer, years. There, the essential thing was just that slow change of the species itself, the develop-
ment of tool capability and spiritual capacity in a continuous progress during hundreds of thousands of years. Here, man as the knowing master experiments with the subjected animal; and only fantasts could imagine something like the recreating of it into an animal possessing higher spiritual capacities. There, man had to create himself, creator and creature at the same time, through his own life-activity. He

VIII. TOOLS AND SPEECH

32. "Tool and speech, according to ancient views, belong to "the most human side of man", thus Karl Bühler commences the

Preface to his work on the theory of language. "According to 'the whole build of his body'", thus he approvingly cites Charles Bell, "man is dependent on tools and speech, is adjusted to tools 'and speech'. 'Speech is akin to tools; it also belongs to the 'implements of life, is an organon just as the material 'implement....' (p. III). Here they are put forward as two independent data, side by side, together determining what is special in man, without an indication of any causal relation between them. This relation, however, is clearly stated, though looked at from one side only, by Grace de Laguna: "It is scarcely 'credible.... that the art of chipping stone implements could 'have been developed by men who had not yet learned to speak. "The belief that the two great human functions are somehow 'causally interdependent, is probably held quite widely at the 'present time." (p. 218). Still clearer, looked at from both sides, Noiré states it in the introduction to his work: "The mutual 'dependence, in uninterrupted interaction, of speech and tool, 'i.e. of thinking and acting, constitutes the leading thread in "these investigations." (p. VIII).

It has already been remarked several times that an efficient use of implements without speech, *i.e.* without words to distinguish them, is hardly possible. Conversely this implies that in the process of development of mankind the use of implements must have influenced human speech.

33. The transition from animal sound to human language is the transition from the utterance of emotion to the pronouncing of names which, as symbols, signify and designate things and actions. How did it happen that certain things came to be designated by certain sounds? For the animal the world is a whole, and although it is variable in that certain changes in aspect signifying danger or food force it into action, it is nevertheless a self-evident whole. That the parts, as separate things, are not recognized as such, is demonstrated by the fact that for us too they acquire that individuality only when we distinguish them by names. In the subsequent increase of knowledge, a field of phenomena often remains a vague and unravelled unity until, when the various parts are named and characterised and well-defined conceptions are introduced, clarity, depth, and

transparency appear. Similarly, man's own body is a self-evident whole, and the spontaneous actions do not lead to discrimination of its parts; in the whole of the world man discovers himself last of all.

Now in this world, self-evident on all sides, the tool becomes apparent as something extraordinary. At one time it is part of the body, in which it is a lifeless component and bodily organ, and at others cast away it is part of the external world; though ever anew sought for and taken up. "The peculiarity and quite 'formidable importance of the tool is to be found in that it is 'at the same time part of the subject and is yet an object." (Noiré, p. 107). The implement is the changing element, belonging now here, now there; it severs the indivisible units and their self-evidence. Attention is, thus, concentrated on it, because it takes its place outside each of the usual worlds. At the same time it is of primary importance through the role it plays in work and in the struggle for life; it stands in the centre of man's activity. Thus a sound accompanying a given action is associated with the object which is the carrier of the action. The object itself is discriminated because a sound attaches itself to it; it gets a name.

Both Geiger and Noiré have expressed the opinion that an initial beginning of language must have existed before the use of implements. "... linguistic study has completely proved 'that man already possessed language before he was in possession of the tool.... Right at the bottom of language-life man 'appears, not yet distinguishable in this respect from animals, 'dependent on the action of his natural organs only." (Noiré, p. 108). It may be; but in what he says further on: "As is 'speech, so also is the tool a characteristic element of man. "Without exception the world of man and the world of animals 'in this respect are opposite." (*l.c.* p. 109) — the author himself throws doubt on whether the name of man can be applied here. Moreover we may be sure that in spite of this sharp division by sharp definitions there must have been transitional forms and intermediate states of a doubtful labelling. Chimpanzees living in groups also accompany their common activity by manifold noises and sounds; in such instances of the simpler forms of providing for life, however, individual picking and

gathering can hardly be called common work. Noiré assumes that in the strenuous conditions of life in the plains the preparing of shelters, the wattling of tree-dwellings, but chiefly the digging of holes created a first necessity for common work; and he supposes that the names for this digging and scratching (*krabben, scharren*) belong to the oldest roots of language, from which many words of later dates can be derived. If that were the case, then it is quite probable that during such scratching and digging-work bits of stone would naturally come into the hands, and that quite as naturally these were used as aids; a long period of common work without this very first mechanical aid would seem to be rather unlikely.

Work and implement are not yet distinguished from each other in the first sounds having the character of names; the same word acts as a symbol for both. Only at a later stage of development is a distinction made between substantive and verb, and the sentences in which the words form replaceable parts begin to take shape. Of course this first forming of words is a collective process; an indication by name makes sense only in a mutual understanding. Consequently we may say that speech came into existence as a means in common work with the aid of implements.

34. Thus the implement has a further influence, as apart from its immediate one, on human thinking. The implement created speech, and speech, because word-symbols have a meaning, produced the forming of clear conceptions and logical thought. This is what Dewey has expressed as follows: "The invention "and use of tools have played a large part in consolidating "meanings, because a tool is a thing used as a means to consequences, instead of being taken directly and physically. It is "intrinsically relational, anticipatory, predictive. . . . The most "convincing evidence that animals do not "think" is found in "the fact that they have no tools, but depend upon their own "relatively-fixed bodily structures to effect results." (14, p. 185). That is to say that the mechanical aid, though at first it was accidentally taken by the hand, thoughtlessly made use of, and thrown away, finally aroused the consciousness of the aim for which it was applied; and thereby the accompanying sound

also receives a certain meaning and becomes a symbol. And he continues to explain this: "A creature might accidentally warm "itself by a fire or use a stick to stir the ground in a way which "furthered the growth of food-plants. But the effect of comfort "ceases with the fire, existentially; a stick even though once "used as a lever would revert to the status of being just a stick, "unless the relationship between it and its consequence were "distinguished and retained. Only language, or some form of "artificial signs, serves to register the relationship and make "it fruitful in other contexts of particular existence." (ib. p. 187).

168 Thus abstract thinking, speech and the use of tools are inseparably connected. And they remain joined in the whole of the further development: a differentiation of the tools to special appropriate forms, a differentiation of the language to an ever greater wealth of deduced appropriate words and compound sentences, a differentiation of thought to ever further logical abstractions. The perfecting and refining of the tools to ever more productive methods of working, the perfecting and refining of language into an ever more adequate means of imparting information and of spiritual intercourse, the perfecting and refining of thinking as a means towards an increasing investigation and a higher knowledge of nature and the world around us, together produce an ever greater wealth of modes and possibilities of life.

35. That the use of tools has had a determining influence on the origin of speech, is also betrayed in the anatomical structure of the brains. The speech centre is located in the cerebral cortex at the foot of the third (the lowest) frontal lobe and its surroundings, as an extension of the motor centres of throat and mouth located nearby, and these are situated in the close vicinity of the motor centres of the arm and the hand. This speech centre is present in the left-hand hemisphere of the brain only; the corresponding parts of the right-hand hemisphere are mute. At least, that is the case with the majority of people, who are right-handed. In the case of the left-handed people the reverse obtains, as for them the speech centre is situated in the right-hand hemisphere of the brains (a few very rare exceptions seem to have occurred). It has been known for a long time that,

owing to a crossing of the nerve fibres, the right-hand half of the body is innervated by the left-hand hemisphere of the brains, and conversely. These facts clearly show that the speech centre is connected with and determined by the use of the hands.

Use of the hands is use of tools. Without tools, any asymmetry in man's actions would be scarcely discernible. As it is however, a slight asymmetry during the first years of life determines and actuates further preferential use of one hand or other. Righthandedness means that the tool whether it is a stick, club, hammer, spoon, or writing pen, is gripped, handled and conducted with the right hand; lefthandedness means that all this is done naturally with the left hand. This practice then determines the forming of the speech centre in the appropriate place.

This is not merely a conclusion drawn from static, anatomical relations; it also appears in dynamic, physiological effects. The case is cited of a lefthanded child with righthanded brothers and sisters. "Her left hand was tied in early childhood till she used "the right hand well, but whereas the other children learned "to speak early. . . . she was fully six years old before she could "talk plainly." (W. Hanna Thomson, p. 241). So too, Elliot Smith states with regard to lefthanded children: "When such children "are compelled to train the right hand, this involves the educa- "tion, so to speak, of the left cerebral hemisphere. . . . This often "leads to a defective control of muscular activities, such for "example as express themselves in stammering, and a difficulty "in learning to read and to recognize words." (p. 186). Whereas speech and the use of hands grow up in a mutual relationship in the ontogenetic development during the first years of life, it is probable that also in the phylogenetic development, *i.e.* in the origin of man, the new use of the hands and the new capacity of speech came into existence and grew in close relation.

The close connection between hand and speech is so striking that it has often been pronounced as causal connection between both. Sometimes the part played here by the hand as a tentacle for orientation in space has been brought forward, such as can be seen with children during their first year of life. But the hands do not serve man for the purpose of groping in space — with a child that function is soon taken over by the eyes, and

it has played no part in the origin of man as a species — but to grasp things and to guide implements, as a working organ.

Or, when technique and manual labour stand beyond the vision of modern scientists, an attempt is made to make the connection understandable in this way, that before speech existed there was a language of gestures residing in the hands, and that these gestures were made by the right hand in particular. Such is indicated in the writings of Elliot Smith. First he points out how very natural one-handedness is: "It must be evident that "one hand only can be usefully employed in executing the "consciously skilled part in any given movement. The other "hand, like the rest of the muscles of the whole body, can be "only auxiliary to it. . . . the forces of natural selection made "one hand more apt to perform skilled movements than the "other" (p. 67). This is then extended into the giving of signs for the purpose of imparting information. "It is easily compre- "hensible why one hand should become more expert than the "other. . . . and the fact remains that it is the right hand, "controlled by the left cerebral hemisphere, which is specially "favoured in this respect. . . . When the Ape-Man attained a "sufficient degree of intelligence to wish to communicate with "his fellows. . . . the more cunning right hand would naturally "play an important part in such gestures and signs. . . ." (p. 68). We may say that all this is not required for the purpose of an explanation, since the "skilled" movements and the "cunning" of the right hand can mean nothing but skill in acting and in grasping things, *i.e.* in handling tools. The practice of this skill must already have stimulated the formation of sounds for imparting information so forcefully, that gestures with the same hand can barely have played a part. The whole reasoning remains vague because the tool, in which the skill of the hand for all practical purpose is realized, is not seen or mentioned.

IX. THE FIRST ORIGIN

36. It has become evident from the foregoing that all the essential characteristics, which distinguish man from the animals stand in a close relationship to one another. They depend on each other; each one needs the other as a condition for its