

# Erich Franke on culture and cognitive development: a forgotten pioneer

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**Abstract:** *In the intellectual climate of early 20th century, when biological racism remained the dominant view, Franke raised doubts about its validity and rejected the then popular 'recapitulationism'. Using drawings made by African children and adults as a measure of intelligence, he found confirmation of the prevailing negative stereotypes. However, he did not interpret this in terms of an innate deficit, but as in the main a consequence of growing up in a constraining cultural context. Hence he anticipated, at least in part, modern ideas about the influence of culture on development.*

**Zusammenfassung:** *Im intellektuellen Klima des frühen 20. Jahrhunderts, als biologischer Rassismus die dominante Perspektive darstellte, äußerte Franke Zweifel an dieser Sichtweise und wies den populären "Rekapitulationismus" zurück. Indem er Zeichnungen von afrikanischen Kindern und Erwachsenen als Intelligenzmaße verwendete fand er die Bestätigung für die vorherrschenden negativen Stereotype. Allerdings interpretierte er diese nicht im Sinn angeborener Defizite, sondern vor allem als Konsequenz des Heranwachsens in einem begrenzten kulturellen Kontext. Auf diese Weise nahm er teilweise moderne Ideen zum Einfluß der Kultur auf die Entwicklung vorweg.*

## The intellectual climate

The 18th-century Enlightenment was characterized by a relatively liberal attitude toward 'savages', who were viewed as representing an early stage of the development of humanity. By the end of that century, writers like Soemmering in Germany, White in Britain, and Virey in France, put forward polygenist views, suggesting that blacks and other savages had a separate origin from that of white Europeans. A notable exception was Johann Friedrich Blumenbach (1752-1840), known as the father of physical anthropology. He pointed out that different races shade into each other, and thought highly of the actual and potential capacities of blacks in particular. However, the tide of scholarly opinion moved against him. Throughout the 19th century, and well into the 20th, purely biological interpretations of race differences remained dominant and were focused primarily on the 'dark races', notably African blacks. Many authorities of the period regarded non-Europeans as constituting distinct species.

Craniologists such as Vogt (1864) sought to show that the brains of blacks resembled those of anthropoid apes. The contrary evidence provided by Tiedemann (1837), who also cited Blumenbach on the intellectual achievements of blacks, was largely ignored. There were two other theories, also biological in character and overlapping to some extent, that were concerned with individual development.

The first of these originated during the early part of the 19th century, and was an attempt to account for the frequently observed fact that black children seemed just as bright as white ones, while black adults were generally believed to be lacking in intelligence. The problem was dealt with by postulating a racially determined 'arrested development', such that the intellectual progress of blacks ceases with the onset of adolescence. The cause usually suggested was the earlier closing of the sutures of the skull, supposed to have prevented further growth of the brain.

The second theory to be discussed is a version of the so-called 'biogenetic law', which is at an altogether more sophisticated level. The initial idea stemmed from Karl von Baer who formulated what became known as von Baer's rule of embryonic resemblance. It states that characteristics held in common by large animal groups usually develop earlier in an embryo than unique features. Darwin took up and elaborated on this notion, but it was Ernst Haeckel who developed the idea most extensively and with whose name the 'biogenetic law' has become associated. In his book entitled *The evolution of man* [1870] (1905) he referred to it as 'the fundamental law of organic evolution which . . . may be briefly expressed in the phrase, "The history of the foetus is a recapitulation of the history of the race"; or, in other words, "Ontogeny is a recapitulation of phylogeny"', (vol. I, p.5). Although originally confined to embryology, it was later extrapolated to post-natal development, notably by G. Stanley Hall who sought to apply it to education (Ross, 1972). The notion of such 'recapitulationism' was that European children, in the course of their development, pass through all the stages of their remote human ancestors and then go on beyond them; but the 'lower races' become arrested at a more primitive level and cease to develop any further. The reasons proposed for this arrest were either just that 'lower races' were biologically programmed in this way, or that at puberty their sexual drive became so powerful as to render them incapable of any more intellectual advance. The 'biogenetic law' was extremely influential, having been adopted by a wide range of prominent thinkers such as James Mark Baldwin (1906) and Freud (Sulloway, 1980). It still stands in its original embryological formulation, though not as applied to post-natal development.

Early in the 20th century, when recapitulationism was at its height, the unorthodox German historian Karl Lamprecht tried to make ingenious use of it. He regarded historical events as being of an essentially psychic nature, so that

any cultural stage is characterized by a collective psychic state [seelischer Gesamtzustand]. This he viewed as a kind of diapason, pervading all mental states, and thereby also all activities, in any given period. Lamprecht also sought to demonstrate that cultural stages succeed each other in a definite order, displaying increasing differentiation. If only one had a psychological tool with which to assess any aspect of mental functioning, this could be applied to various primitive peoples and then their positions on the evolutionary scale could be identified. It so happened that at that time there was great interest in the drawings of children and 'savages'. Writers like Kretzschmar (1910) or Vierkandt (1912) had shown from the results of cross-cultural developmental studies of children's drawings that the major stages were similar everywhere: from scribbles to schemata to phenomenal representations. This was taken to mean that drawing style could be used as a measure across cultures, and Lamprecht thought that he had found the key that he needed for unlocking the evolutionary sequence:

... one will be able to establish a sequence of stages of *psychogenetic* development valid for children all over the world; as regards the higher of these stages, it will be possible to order the character of the known *philogenetic* stages of development (Lamprecht, 1912, p.137; my emphases).

The underlying assumption here was one of unilinear progress from savagery to civilization of the kind postulated by social evolutionists such as Herbert Spencer and Edward Tylor. The social evolutionists were not race theorists, though they came to be affected by the prevailing racist ethos in their later writings. Generally they belonged to a minority school of thought that supported the idea of the fundamental equality of potential of all human groups. This had been true for instance of James Prichard in England or Theodor Waitz and Adolf Bastian in Germany (cf. Jahoda, 1992). At the turn of the century in America Franz Boas, a former disciple of Bastian, began to argue powerfully for culture as opposed to race as an explanatory concept. His influence in that direction has been lucidly described by Barkan (1992).

This sketch of the climate of opinions, while unavoidably brief and superficial, should indicate the prevailing tension between biological racism and its critics. During the first two decades of the 20th century, when Franke elaborated his thesis, biological determinism was still dominant; but the protagonists of environmental and cultural factors were steadily gaining ground.

## Franke's background

Erich Franke was a teacher at a Realschule in Leipzig, and I have not been able to obtain any further information about his life. It is certain that he never went

to Africa or carried out any empirical studies of black children, so that his work was purely theoretical, though based on a vast array of field reports. His extensive and ambitious study of The mental development of Negro children (Franke, 1915) was subtitled 'a contribution to the question of the hindrances to cultural development'; this epitomizes the general theme of the work, concerned with the relationship between individual development and culture. It would seem that the inspiration for this task came primarily from Johannes Kretzschmar, whose help and advice he acknowledged in his foreword. It will be remembered that Kretzschmar was one of those who devised methods for what we would now call the 'scaling' of drawings, ranging from mere 'scribbling' via several levels of 'schematic drawing' to phenomenally appropriate representation [Erscheinungsgemässige Darstellung]. He was also helped by his former teacher, Karl Weule, a field anthropologist with a certain skepticism as regards the then usual 'racial' explanations of ethnic differences. Weule worked in East Africa and provided Franke with some of his drawings by Africans. Franke was also in direct contact with Lamprecht, who let him have drawings by black children from his extensive collection. It was from Lamprecht that Franke initially borrowed the idea of a relationship between the mental development of individuals, as judged by their drawing style, and the history of cultures (1). Franke's reading was very wide. From internal evidence it is clear that he was familiar with the work of nearly all those mentioned in the above introduction, and of numerous other less important figures. Yet far from merely echoing the views of others, he had a sufficiently original mind to attempt his own synthesis.

### Franke's thesis

At the outset Franke considered the factors making for cultural progression on the assumption of monogenism, i.e. the common origin of all humans. For him, as for Lamprecht, psychological development [die Entfaltung des menschlichen Geistes] was fundamental. Such development he regarded as a function of the interaction between mind and environment, external stimuli being necessary to produce changes in mentality. Although Franke had of course read Wundt and referred to him in connection with children's drawings, he made no mention of Wundt's key notion of the effects of social interaction.

Franke actually expressed clear reservations with regard to the concept of 'race', which he saw as essentially a mere classificatory principle [Einteilungsprinzip]. As had Blumenbach before him, he regarded ethnic diversification as the product of environmental influences. He reviewed various claims that there are innate limitations to cultural progress, only to reject them. Following

Lamprecht, he stressed the importance of comparative child psychology for understanding the processes of culture change. However, he did not accept Lamprecht's assumption of a parallelism between ontogeny and phylogeny as implied by recapitulationism, adopting a radically different position:

Contrary to what is often claimed on the basis of Haeckel's 'biogenetic law', ontogenetic mental development is not a lawful mechanical recapitulation of phylogenetic development . . . (p.9)

The central issue Franke wanted to address concerned 'the kind of causal relationship that exists between ontogenesis and phylogenesis' (p.9). The hypothesis which guided his study was that individual development is primary, and the collective cultural level secondary; in other words, ontogeny is the cause of phylogeny.

The first and crucial step in Franke's investigation was the establishment of the nature of intellectual development among African children by what he took to be an objective method. He believed that children's drawings could serve as instruments for throwing light on thought processes and thereby provide a measure of intellectual development. It was a reasonable assumption at the time, but one we now know to be subject to a number of important reservations of which he was unaware. Some of the shortcomings of his approach are, in hindsight, glaringly obvious and will be briefly mentioned. Franke had neither control of, nor in most cases even adequate information about the conditions under which the drawings were made. For instance, were the instructions open-ended, or did they specify particular objects to be drawn? Where one child made several drawings, what was their sequence? (2). Franke in a footnote mentioned the problem of ascertaining correct ages in pre-literate cultures, only to dismiss it; but it can be a source of substantial errors. The fact that the kinds of objects drawn varied widely and haphazardly across ages rendered systematic comparisons almost impossible. What he did was to broadly categorize the drawings according to the scheme mentioned above, which involved a high degree of subjective judgement of unknown reliability. In effect, from our current standpoint, the material was largely uninterpretable.

At the time, Franke was of course innocent of all these objections. He analysed more than 3000 drawings of Africans aged between about four and forty years, comparing them with drawings made by German children. It is neither possible, nor necessary, to present here the minutiae of the lengthy and painstaking analysis undertaken. Suffice it to say that for Franke, as for other writers of the period, the criterion of mature (i.e. European) thought was a representation that corresponded closely to phenomenal appearance. This means that the child draws in adequate detail not what she knows, but what she actually sees. By this criterion the Africans were clearly backward, locked into more

primitive modes of representation. After the age of about 4-7 a plateau was reached, which also characterized the drawings of adults. Franke's tentative conclusions were as follows:

So far, we can note on the basis of the drawings that the development of awareness of reality here consists only in the grasp of content details; awareness of the organic connections of the individual parts of an object and its proportions does not seem to have emerged; thereby . . . the higher awareness of the logical necessity of linking the form of the representation to its appearance is lacking. (pp.79/80)

Franke observed that this fitted in with the many reports about the relatively rapid maturation of Negroes and the subsequent arrest in development. He did, however, notice that the drawings of black children who had attended school were superior to those of children without any schooling. Consequently, much to his credit, he thought that the the arrest could not be attributed simply to innate limitations, as was then usually done; rather he suggested that it might well be culturally determined. In order to verify this, other possible factors had to be excluded - above all bodily development, which he more or less equated with 'race'.

On surveying the literature Franke concluded that rate and duration of physical growth were not substantially different from those of Europeans, physical growth continuing after puberty. On the frequently-voiced view that the awakening of the sexual life among Negroes results in arrested development, Franke commented that that there probably is a connection, but not the one commonly adduced:

But if a link is present, it is not to be sought in the presence of the awakening sexual life as such, but above all in the manner in which the Negro permits the awakening sexual life to influence his mind. It would mean that the awakening of sexual life constitutes in certain respects a condition for mental arrest, but is not its cause. It is precisely this point that will prevent us from seeking the grounds for the arrest solely in the bodily sphere, and directs us towards the manifestations and institutions of the mental culture surrounding the Negro (p.109).(3)

Franke then went on to review the literature in order to eliminate, as far as possible, other rival organic hypotheses. The first of these concerned the alleged premature closure of the sutures, and he found that there was no real evidence for that.

Another had to do with the growth of the skull as a supposed limiting factor for brain growth. While not altogether rejecting this as a possible contributory factor, he concluded that it could only constitute a very minor one. His acceptance of the old view put forward by Broca and others that education enlarges the brain, enabled him to subsume even this factor under the general umbrella of culture.

There follows a chapter summarizing the numerous reports about early maturity and arrest of development, which he seems to have accepted at face value. Next he sought to trace, on the basis of numerous anecdotal writings as well as ethnographic reports, the development of basic mental processes in Negro children. The picture that emerged substantially reflected the then prevalent stereotypes: a very slow emergence of the sense of self that stops short of the capacity for reflexivity; fantasy manifest in play but, together with curiosity, disappearing soon; little development of logical, moral and aesthetic capacity; on the other hand strong and early imitativeness, a good memory, and well-developed bodily skills. All this meant, according to Franke, that the Negro child soon approximates the adult, but also that the development of higher mental abilities is inhibited.

Franke, lacking any first-hand contact with the Africans about whom he wrote, uncritically accepted that dismal portrait. Where he differed from most of those whose descriptions he adopted, is in his refusal to attribute these characteristics simply to 'race'. As is evident from a chapter entitled *The influence of education and the cultural environment on the development of the Negro child*, he was a precursor of the modern ideas concerning socialization. Franke tried to demonstrate, with the aid of rich and detailed ethnographic material, the ways in which the cultural context influences and constrains mental development. Here are some points from his summary:

We see the child at an early stage getting used to the imitation of adults, and his fantasy is soon suppressed by getting used to adult work . . . Memory and imitativeness develop in the context of work and play, and an outlook on life is created that is content with what is. Early in life customs and traditions exert their influence through legends, songs and dances; and by the powerful application of superstition the spirit of tribal life is drummed into the child. Brought up . . . to respect parents and elders, as well as the customs and traditions of the tribe, the child wants nothing better than to be accepted into the circle of adults and to live the life of the ancestors.

The whole cultural development moves towards the adoption of the material and spiritual cultural possessions of adults, without going beyond it. The mind of the young person is directed ever more firmly towards the outlook of the ancestors through puberty rites and in the organisations of men's houses and secret societies; and thereby, and also through extraordinarily strong emphasis on the sexual drive, he is made dull and hardly receptive to the influence of another culture (pp.258/9).

Franke blamed mainly cultural elements for the arrested development, whose reality he regarded as further confirmed by the evidence of the drawings. In particular, he identified the cultural stress on sexual gratification, and slavish adherence to tradition, as the major causal factors. Unlike many others, he did

not regard blacks as innately and permanently mentally inferior. He believed that the potential was there for change brought about by education, but thought that it would take a long time for Negroes to rise to a higher cultural level.

As far as theory is concerned, he evidently considered his initial hypothesis to have been largely supported:

Only an examination of the ontogenetic development of individuals belonging to different peoples will bring us closer to the causal explanation of the prevailing phylogenetic level of development of a people. (p.264).

In other words, ontogeny causes phylogen. The work ends with a discussion of the implications of his analysis. At the outset one finds some slight equivocation when Franke cautiously conceded that one could not deny that the racial factor might play some part, albeit a minor and not permanent one. What was needed, he contended, was another kind of education, but its impact would be very gradual. On the positive side was what Franke, accepting the prevailing stereotype, saw as the Negro's great facility for imitation; as against that, there was the heavy burden of tradition acting as a brake. Hence he supposed that it would take centuries for the Negro to achieve a higher culture.

Finally some applied lessons were drawn for colonial education policies. Schooling for Africans should not primarily aim at the mastery of intellectual tasks, but should stress craft skills and habits of steady work (4). Above all, pupils should be kept at school well after puberty, lest the traditional environment prompt them to squander all their energies on sex instead of concentrating on useful learning.

## Discussion

Little is known to me about the reception of Franke's work, except that William Stern (1915) reviewed it, on the whole favourably. Stern had three main critiques: it is mainly ,papieren', i.e. an armchair effort; it treats blacks as a unity, as though they were all alike; and apart from the drawings the comparisons with white children are based on *Vulgärpsychologie*, since not enough was yet known about the development of white children. These points are well taken, and Stern commented further that the contrast between blacks and whites is so great that in spite of these shortcomings, some of the main findings emerge with certainty' (p. 460).

Turning now to the work itself, it should be said that my condensed account fails to convey the immense amount of labour that must have gone into the study, which entailed a scrutiny of the by then extensive literature in several languages. The only child psychologist frequently cited was Sully (1896), while Baldwin was mentioned occasionally. The most conspicuous absence was that of William



Preyer (1841-1897), an important figure in the history of developmental psychology (cf. Eckardt, Bringmann & Sprung, 1985). Another source often used by Franke was a compilation by Ploss (1911/12), of the kind popular at the time, dealing mainly with the children of 'primitives'. Franke tried hard to remain critical and objective, but he was not immune to the prevailing *Zeitgeist*. Consequently his work is a curious mixture of old-fashioned prejudices and novel ideas. It is probably also partly for this reason that his contribution has been insufficiently credited.

Paradoxically, Franke himself saw his primary task as that of helping to elucidate the relationship between ontogenesis and phylogenesis. He failed to appreciate that his formulation was fatally flawed by circularity, as becomes evident if one directly juxtaposes his dual claims: (a) the individual is bound to be incapable of going beyond the limits set by his/her culture; (b) the culture constitutes the highest common denominator achieved by individual development. Hence the proposal of a causal relationship between these terms is illusory. By contrast, the great merit of Franke was to have highlighted the role of cultural influences on mental development at a time when racial explanations still greatly predominated, and several decades were to pass before such a view had become generally accepted.

There are some resemblances between Franke's standpoint and that of Lévy-Bruhl. Both men tried to explain differences in mental functioning, and neither based their theses on biological theorizing. But while Franke has been largely forgotten, Lévy-Bruhl was a towering figure whose work was enormously influential. Surprisingly Lévy-Bruhl, whose book on 'primitive mentality' had appeared in 1910, does not figure in Franke's references. Since his work had become known in Germany, it seems unlikely that Franke had not come across it (5). Later, in a rather slight piece (Franke, 1926), he mentioned Lévy-Bruhl briefly in passing. What is interesting in that piece is that Franke had evidently moved towards a more realistic appreciation of Africans; he had recognized their aspirations in the economic and political spheres and for eventual equality with whites - he was no longer thinking in terms of centuries!

As already mentioned, the other prominent figure whose writings also stressed culture as against race, was Boas. In Franke's main work there is one reference to Boas on the anthropology of North American Indians; another concerns a study on bodily changes of children of immigrants (Boas, 1912), in the context of the effects of the geographical environment on bodily growth. Actually that was not Boas' main report, but referred to the attacks on the study, mainly by European physical anthropologists (cf. Stocking, 1982); it is doubtful whether at that time Franke had really understood the wider implications of the work of Boas. Later Franke (1929) contributed a chapter to a memorial volume

on Weule, and by that time had evidently become better acquainted with Boas' thought; he then, with some justification, regarded it as confirmation of his own views. Otherwise the chapter consists essentially of a restatement of his thesis, supplemented by a discussion of the subsequent literature.

In conclusion, Franke did make an important original contribution by pointing to the crucial role of culture in relation to individual development and what we now call 'socialization'; moreover, he also saw that such processes are linked to culture change. Lévy-Bruhl never touched on the issue of development. Wundt's *Völkerpsychologie* was intended to deal with the universally operating processes which account for cultural development in general. But he did not think that this had any connection with child psychology, whose importance he believed to be much overrated (Wundt, 1917). Boas in later life did fully recognize the relevance of socialization, encouraging his student Margaret Mead to study it in the field. But he was anticipated by Franke, who to my knowledge was the first to formulate the issue quite explicitly. As a transitional figure, some of his thought was still rooted in the older ideas, yet in some important respects he broke away from them. Franke was unlucky that his work came out during war time, when people were preoccupied with other things. After the war Germany lost her colonies, otherwise it might well have excited much more interest. There is also the fact that he wrote in German and was never translated, and as a consequence of all that sank into obscurity. It seems to me that he deserves to be remembered.

## Notes

- (1) This gave rise to much empirical work on the drawings of children, *Naturvölker*, and prehistoric peoples, and led to lively debates over many years. For further details of this whole episode cf. Jahoda (1991).
- (2) This is important, for it has been shown (e.g. Fortes, 1940) that children who use a pencil for the first time start with mere squiggles but later produce more representational drawings even when there is no tradition of figurative art in their culture. For a general discussion of drawing types in cross-cultural context cf. Deregowski (1980).
- (3) Franke often cited Kidd (1906) who had written, that the imagination in the Kafirs runs to seed after puberty: it would be truer to say that it runs to sex (pp. XIII/IVX).
- (4) This recommendation was nothing new, based as it was on the centuries-old stereotype of the 'lazy Negro'; in practice it meant that blacks were often

reluctant to do the kind of work Europeans wanted them to do. It used to be one of the main objectives of colonial rulers to change this attitude. For instance, a statement of *Education Policy in British Tropical Africa* (1925) stressed the importance of the 'discipline of work' and the need for the, formation of habits of industry'.

- (5) It is possible that he did not think it politic to mention a prominent French intellectual such as Lévy-Bruhl at a time of acute Chauvinism amidst the First World War; as against this, he did not refrain from citing numerous other French authors. A more plausible interpretation would be that he may have been unaware of the relevance of the Lévy-Bruhl thesis for his own work.

## End note

I wish to record my gratitude to Bernd Krewer, Universität des Saarlandes, without whose help I would not have had access to the necessary materials.

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K13

DA 16 12 Bsp. 7 1/2

Fig. 16



K. 8 Mann

Fig. 17



K11 Krabe

DA 16 11

Fig. 18



DA 16 9

K9 Flirt

Fig. 19



K10

Kgr 145

Fig. 20



K12

Mann

Kgr 1 8

Fig. 21



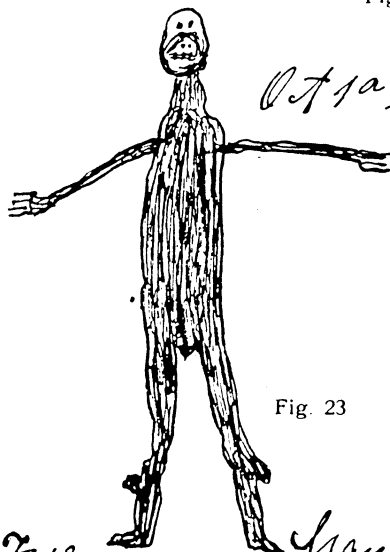
K9 Krieger

DA 16 1

Fig. 22



K14



DA 16 21

Fig. 23

Kgr 3 74

Fig. 24



Binske

Bsp. 16

K8 Frau

Fig. 25



K13 Frau

DA 16 14

Fig. 26

K12

Mann

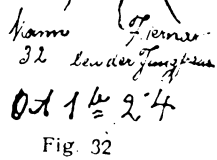
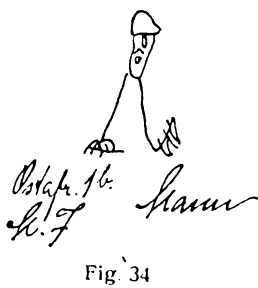
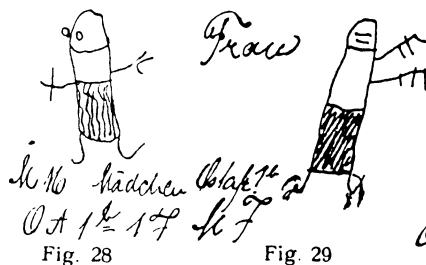
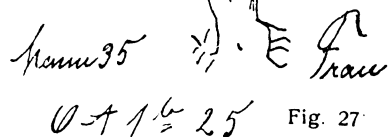
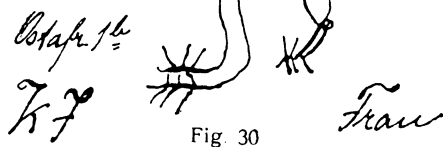
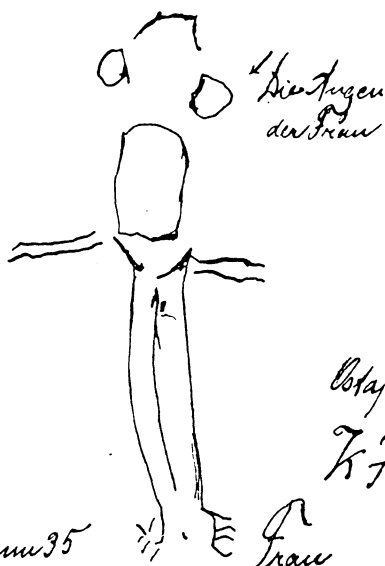




Fig. 35



Fig. 38



Fig. 40

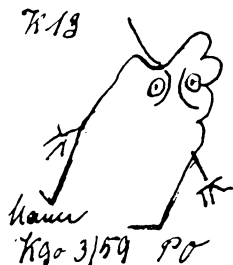


Fig. 36



Fig. 39

at  
1a4



Fig. 37



Fig. 42



Fig. 41

K10  
at 1a2

K10  
at 1a18

Knabe  
Krumm  
Schule trägt  
Tafel Bucher  
mit Stoff



K 14

Ost 1<sup>a</sup> 4

Fig. 43

Knabe

K 10

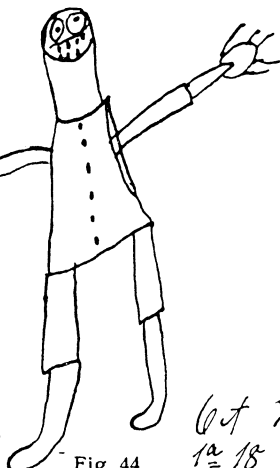


Fig. 44

Kann  
mit  
Schirm

Ost K 10

1<sup>a</sup> 18 Ost 1<sup>a</sup> 13

Fig. 45

K 11

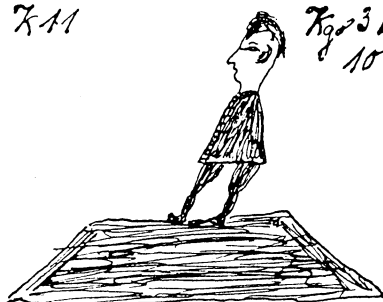


Fig. 46

Kind

K 9 3 E  
10 5

## 3. Tierdarstellung.

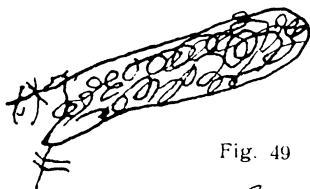


Fig. 49

Ost 1<sup>a</sup> K 4

Leopard

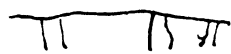


K 20

K 9 3 K

10 4

Fig. 47



K 9 Leopard

Ost 1<sup>a</sup> 6

Fig. 48





hamm 25 Büffel

0A 1 1/2 2 1

Fig. 70



0A 1 1/2 16

K 8 Schaf

Fig. 71

0A 1 1/2 16

K 8



Ziege

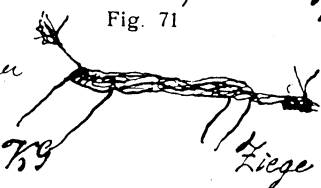
Fig. 72



K 9

0A 1 1/2 8

Fig. 73

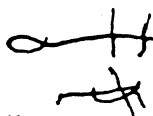


K 9

Ziege

0A 1 1/2 9

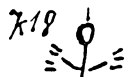
Fig. 74



0A 1 1/2 16

Affen

Fig. 75



K 18

Emerg. magu

0A 1 1/2 19

Fig. 76



0A 1 1/2 16

K 8

Affen

Fig. 77



K 14

Giraffe

0A 1 1/2 15

Fig. 78



K 14

0A 1 1/2 15

Fig. 79



K 13 Hase

0A 1 1/2 14

Fig. 80

hamm 26



Chamäleon

0A 1 1/2 26

Fig. 81

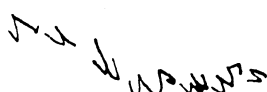


K 12

Frosch

0A 1 1/2 3

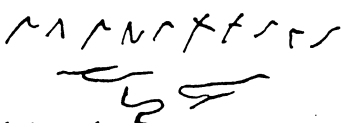
Fig. 82



K 9

0A 1 1/2 8

Fig. 83



0A 1 1/2 16

K 8

Fig. 84

Vogel



hamm 15 Vogel

0A 1 1/2 21

Fig. 85



01 1 1/2 8

Fig. 86

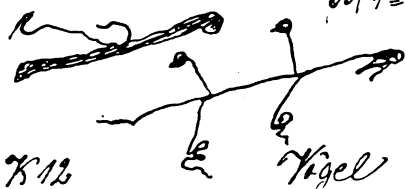


Fig. 87



01 16 14

Fig. 88



Fig. 89

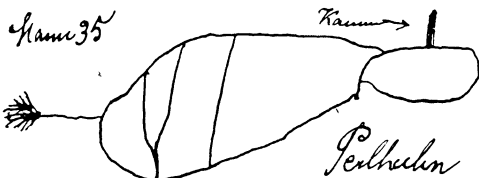


Fig. 90

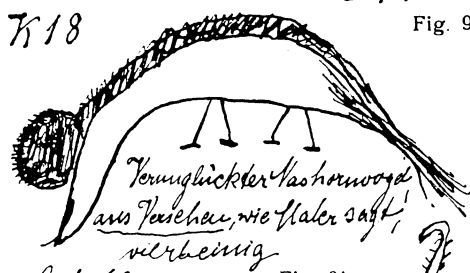


Fig. 91



Fig. 92



Fig. 93

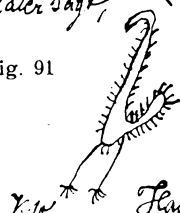


Fig. 94



Fig. 95

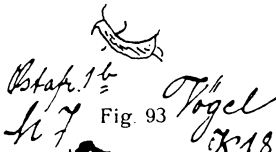


Fig. 96

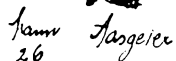


Fig. 97



Fig. 98



Fig. 99

Fig. 99



Fisch

Kgr 1 8

K9

Tausendfischer

Fig. 100

Alt 1 1/2 5 9 11 6

#### 4. Gerätedarstellung.

Alt 1 1/2 20

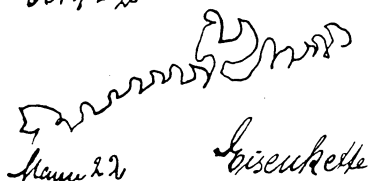
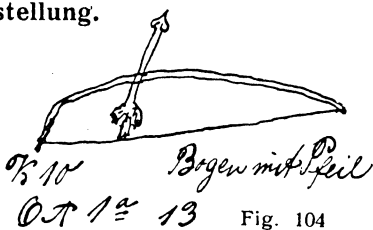


Fig. 101



Alt 1 1/2 13

Fig. 104

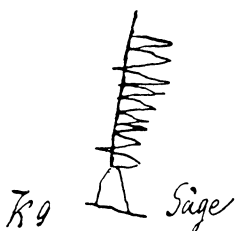


Fig. 102

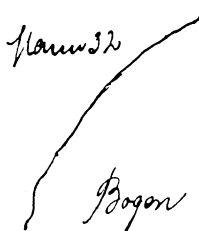


Fig. 103

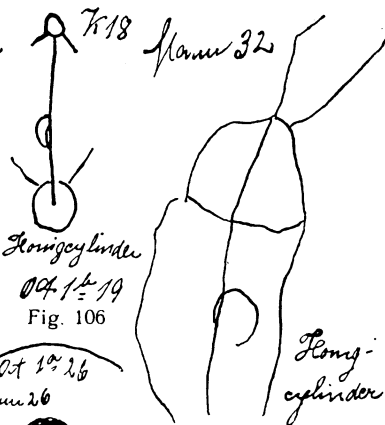


Fig. 106

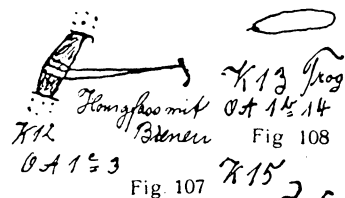


Fig. 107

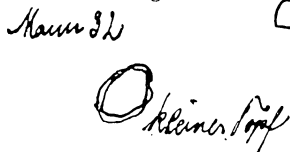


Fig. 109

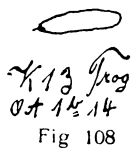


Fig. 108

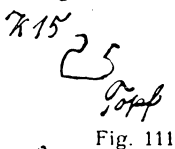


Fig. 111

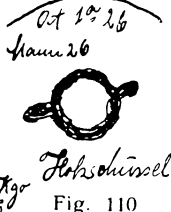


Fig. 110

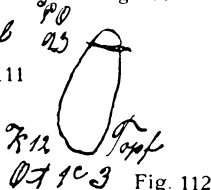


Fig. 112

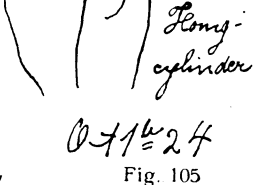


Fig. 105

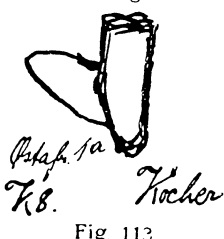


Fig. 113

