

The Forms and Functions of the Oldest Tools

(A reply to Prof. F. Bordes)¹

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Our dispute with F. Bordes resembles the quarrel of two fishermen standing on the opposite banks of the river who are trying to shout each other down. It is difficult, indeed, to find the points of contact for scholars with such opposite attitudes. In such a polemic the worst course would be to blame opponents for misunderstanding data presented in their works or to plead not guilty when it is unknown which of disputants is a real sinner.

In the situation it is important to avoid speaking of particulars or some minor methodical obscurities and concentrate attention upon principal methodological issues. Polemics of this kind will be of significance not so much for disputing scholars, who probably will not change their attitudes, but for the wide circles of readers who will be capable of forming their own judgement about it. Exactly such principal problems will be dealt with here, albeit it would be impossible to ignore some particulars playing no insignificant part in estimating methods under discussion.

The contributions of F. Bordes to palaeolithic studies are known and his opinions can't be ignored. But, as it happens very often, authority and prestige once gained render to science a bad service when any thought expressed by the authority in the past is defended in the later works.

The article to be dealt with, the one which gave rise to the discussion, was written by F. Bordes in a hurry and supplied with sketchy pictures. The young scholar fascinated by some successes in working stone by wood was not slow in presenting them as a rule. He mistook them for the discovery which upturned all our conceptions of palaeolithic technique. On page 12² the author writes that it is possible to begin the percussion of pebbles (galet) with a wooden striker (buton – rondin), however, for this one must use a big “rondin” which is somewhat unhandy (peu maniable). All experimentors know that to strike off flakes from round pebbles with wooden strikers is impossible, irrespectively of their sizes, not because they are unhandy. The first blows on pebbles done with strikers of oak, boxwood or even horn (which is harder than boxwood) will yield no results. One needs a stone striker. The striker is needed not only for the first blows when the massive part of flint is removed. Oak or boxwood strikers are efficient only in blowing on sharp edges of flint artefacts.

In his reply to our criticism of “the stick technique” F. Bordes did not prove the possibility of flaking a flint into prismatic blades by wooden strikers. The Table I³ presents horn strikers and intermediaries rather than wooden ones, albeit in the text the author insistently speaks of the latters. What is the reason for it? Rough blades given on the Table III and shown only from the ventral face were flaked by horn rather than wooden strikers. If presented photographs had been intended as documents the text should have been supplemented by “the stick technique”. Numerous experiments have convinced us the best intermediaries (chasse-lame) are horn ones. Wooden intermediaries were useless in making blades (lames). Striking on cores, when boxwood strikers (percuteurs) were used, required an enormous force, but as a result we

¹ F. Bordes, *Considérations sur la Typologie et les techniques dans le Paléolithique*. Quartär 18, 1967.

² F. Bordes, *Études comparatives des différentes techniques de taille du silex et des roches dures*. L'Anthropologie, 51, 1947.

³ F. Bordes, *Op. cit.* 1967.

obtained rough irregular flakes with a wide platform at the top. It was difficult to call them "blades". Such blows made a box striker unserviceable very soon and it had to be trimmed by an axe to smooth its spoiled surface.

Speaking of box-tree one should have in mind that the tree did not grow in the periglacial zone of Europe with its subarctic climate while antler was always available in abundance.

F. Bordes has good reasons for reproaching me with my insufficient proficiency in French. It might have resulted in misunderstanding some nuances of the French text. I deplore it. But there is not the slightest doubt that my opponent does not know Russian at all, otherwise he would have used the original of my book "Prehistoric Technology" published in 1957 rather than its translation⁴ (good at it is). This ignorance explains also why F. Bordes does not know my other works dealing with the technique of stone working, e. g. "Studying Prehistoric Techniques by Means of Experiments" (in "New Methods in the Archaeological Investigations", M.-L., 1963), where the problem of working stone with wood and horn were considered in a more detailed way on the basis of data found by the Crimea expedition.

Reverting to the subject of "the stick technique" I would like to emphasize that some secondary operations in working flint tools can be carried out with wooden strikers, as it was stated on page 54 of the Russian edition of "Prehistoric Technology". F. Bordes himself points out the necessity of preparing flint pebbles or nodules with stone strikers in order to get a sharp edge for subsequent working with hard wooden ones. Flakes struck off with wooden strikers had, of course, a narrower section in manufacturing Acheulian hand-choppers, or to be more precise, their final retouching might have been done with wooden tools. Precisely this I maintained in my book "Prehistoric Technology". But the initial working of flint nodules or pebbles when concretions or pebbles had to be broken, their cortex removed, and flakes of Mousterian or Levallois type struck off, these must have been done with striker-stones. The reason for it is not only that using wooden tools (when it is possible, e. g. in working with boxwood strikers) requires enormous physical efforts. There is another reason for it. F. Bordes should have investigated, by means of a binocular microscope or even a simple magnifying glass, striking platforms on flakes of common Mousterian or Levallois type. He would not have been long in noticing very important signs showing blows done with stone rather than wooden strikers.

The microsigns are "peep-holes", small round cracks in the points of blow application. Wooden strikers could not have left these signs. Wood as a weaker material could not have produced the "peep-holes" even if the blows were successful enough to strike off a flake from a core. It would be damaged by stone. Neither a horn striker could have left the signs.

Our opponent tries to impute to us the opinion according to which burin facets on the retouched blades did not serve for cutting horn but only for forming the tool part to be mounted in a handle. In the chapter dealing with burins and burin facets we only showed that burin facets were used not only for forming the working part of burins, though it was their main function. We presented some microphotographs showing the character of wear caused by work on the side edges of burin working parts. But at the same time we found out that the technique of burin facets was used not only for forming the working parts of burins, but for many other purposes, too, particularly, for removing sharp edges from prismatic blades when the edges for some reason made the tool unhandy, as well as forming the tool part to hold etc. In these cases the length of facets or asymmetry was not of importance. Driving a burin end (a narrower one) in the spongy mass of a horn segment soaked in water increases the firmness of its hafting. It was tested in the experiments. F. Bordes should do it also. Once again we should like to stress that the alleged reduction of all functions of burin facet only to the protection of hand is the misconception of our book.

As for working wood with flint burins we do not exclude such a possibility for palaeolithic. Working

⁴ S. A. Semenov, *Prehistoric Technology*. London 1964.

wood might have been fulfilled by some multifacet "burins" used rather in the capacity of cutters. There is a difference between the two kinds of tools. A cutter cuts away wider shavings and was used mostly in mesolithic and neolithic times for making utensils.

F. Bordes points out the "naive conception of the continuous progress of mankind" allegedly found by him in our book contending that we ignore obvious facts, e. g. the decline of technique in transition from Solutrian to Magdalenian. Indeed, in our works, particularly in the "Development of the Technique in the Stone Age" (1968) we are trying to find out the general regularities of technical advance which are peculiar not to single areas or zones, all the more cultures, but to the process of the tool development as a whole. Problems of such a kind pertaining to the main trends of the transformation activity of mankind were not raised by archaeologists. But I do not think and this is not implied in my works that the phenomena of decline and stagnation in various spheres of activity are not possible in the single countries or cultures.

In the Magdalenian of Europe, particularly in France, the technique of making laurel-leaf-shaped and shouldered points disappeared; one finds a decline in flaking stone into prismatic blades. But the technique of making bone tools, including points and even harpoons, shows the signs of marked progress. Transferring the centers of attention from some areas of production and materials to others creates not infrequently the impression of decline or stagnation. However, more attentive analysis allow to conclude that considerable technical advance had taken place in other areas, albeit the advance can not be immediately seen.

In F. Bordes' article there are a number of reproofs worthy to be paid attention to. We can agree with some of them, if only partially. Our opponent has some reasons to contend that the technique of retouching microlithes reconstructed by us in page 65, Fig. 2 is a step towards "searching difficulties". Subsequent experiments have shown that retouching microlithes (lunate, trapeze, triangular shapes) is more efficient when it is done on a wood support without a device having a notch. Nevertheless, it would be rather difficult to work microlithes of 2-2,5 mm width discovered on the sites of the USSR or received by us from India (Maisur) without the device.

We do not insist now on the use of flint-tipped intermediaries in flaking prismatic blades (Fig. 2, p. 54), as we believed before. We have managed to get thousands of prismatic flint blades from cores using a horn intermediary and wooden batons. The technique is described and presented in our last book ("The Development of Technique in the Stone Age", 1968, p. 47, Fig. 6). Nevertheless, the traces of holes, scratches, and cracks found on the platforms of prismatic blades and cores (p. 49-51) still can not be explained in a satisfactory way. The interpretation proposed by F. Bordes who believes them to be a result of the horn tool pressure, is not, to our mind, a conclusive one.

At the same time we do not regard prismatic blades of all sizes as being flaked by striking on intermediaries with a baton. Prismatic microblades from such materials as chalcedony, obsidian might have been obtained by applying pressure to the edge of the core platforms.

Among F. Bordes' criticisms of my book there are many which do not require any answer. They are: an example with a basket-maker driving his tools into the ground; sceptical attitude towards pressure retouch in Mousterian times; the position of a biface during its working; our alleged incapability to distinguish between the traces of wear left by the tool use and traces due to natural causes (solifluction) etc.

F. Bordes admits that "a morphologic typology has a descriptive character and does not study the way of using tools. It must not be blamed for it" (p. 26). -- Not blaming it at all, for a child must not be blamed for its small height, we suppose it will be quite appropriate to mention some of the rules of the methodology of science which summarizes the historical development of knowledge. "The description, according to one of the rules, is an enumeration of the marks of an object. It is used when one must deal with objects which can not be determined as their specific characters still have not been discovered."

If a method does not allow one to define objects studied (to reveal their nature) and confines itself to description not infrequently to a subjective one, the method is not adequate for classification and generalisation.

In an earlier work⁵ F. Bordes enlarged considerably the scopes of typology referring to the typology of the palaeolithic as to a science allowing to identify, define and classify various tools found in the sediments of the long periods of the humanity evolution. In the same work he is compelled to admit great difficulties in creating the nomenclature and classification of tools for he retains a heterogeneous origin in the nomenclature.

At the same time he criticizes those scholars who do not agree with the situation calling them "the fanatics of standardisation". F. Bordes does not consider the heterogeneity and, hence, the relativity of nomenclature as a great defect of it. All difficulties will be settled if palaeolithologists come to mutual agreement about the meanings of terms used. However, with some regret, he must admit that there is no such an agreement now and disputes are continuing. F. Bordes argues with many authors about the term "toothed" tools called by his opponent E. Pittard "tools with scallops", but "teeth" and "scallops" are two different things. The first are not round while the seconds are.

If the method is a descriptive one and nomenclature is based on studying forms only the unusual variability of the form of palaeolithic tools excludes the agreement among archaeologists on such basis in the future, too. But for F. Bordes some difficulties presents only the existence of composed types, the types which do not fall under a definite category⁶, as, e. g. a tool combining in itself a side-scraper, burin and awl having, in addition, teeth on the second side edge. Such tools he ranks among the "various" ones. Less complicated tools of this kind combine a scraper and a burin, scraper and awl etc. In upper palaeolithic times one very often finds a scraper-burin.

The solution of the difficulties for F. Bordes is rather simple: in a less complicated tool, the typical form overcomes atypical ones. For instance, in a scraper in which its serrated edge is worse than its scraper edge and the scraper side must dominate so that the tool falls under the category of "scraper". And, vice versa, when a toothed edge is better than a scraper one, the tool must be referred to as "toothed". In an other case of a composite tool a rare form overcomes a typical form. For instance, a scraper-burin will be classified as a burin but with mentioning that in this case the burin is placed on a scraper. One more example: if on a scraper there are features peculiar for a marked skin-scraper (skrebok) the latter must be preferred, for the skin-scraper (grattoir) is an uncommon phenomenon in middle palaeolithic times. If in a twin tool both toothedness and the scraper features are marked equally well and, at the same time, each of the tools belongs to a rare type, the duality must be noted.

The author admits the principles of classifications proposed by him to be of a pragmatic nature and intended for statistical studying of palaeolithic tools. We should call such a classification "formal-pragmatic one" as it is not interested in referents of terms produced. What is it the toothed tool? Why was it made serrated? Besides, the major difference in respect to form and size of flint tools causes them to fall under the category: toothed with a trimmed back (denticulé a dos abattu) – elongated, knife-shaped; toothed subcircular (denticulé subcirculaire); toothed at the end (denticulé en bout) etc.⁷. The degrees of the serration are far from being equal and sometimes it is even doubtful. Teeth one may find on flakes (éclat), bifaces, scrapers (reclor) and other categories of tools where they are ignored by typologists. Here the author betrays the principle of morphological accuracy which, as it seemed, was so precious to him.

F. Bordes has put much effort into his classification and improved it in some respects. But it is still far from meeting requirements of a truly scientific classification which can be constructed on a functional ba-

⁵ F. Bordes, *Typologie du Paléolithique ancien et moyen*, I. Bordeaux 1961, p. 1.

⁶ F. Bordes, *Op. cit.* 1961, p. 10.

⁷ F. Bordes, *Op. cit.* 1961, p. 40.

sis. In order to find some points of contact with the nomenclature accepted by French palaeolithologists let us consider two different kinds of scrapers called in French "racloir" and "grattoir", respectively ("skobel" and "skrebok" in Russian). They are named on the basis of their functions. To our mind, the term "skobel" (racloir) is expedient to reserve for a tool designed for working wood, horn and bone. "Skrebok" (grattoir) is used as a skin-scraper. But even if we come to an agreement about, many questions will be left unsettled. F. Bordes includes in the category of skin-scrapers the following ones: simple, typical, atypical, tending towards being keel-shaped (tendant vers les grattoirs carénés court). While the scrapers for wood etc. are: with back trimming (à dos aminci), with alternate retouch (à retouche alterne), transversal convex-concave clactonian, transversal convex semi-Quina (transversal convex demi-Quina) etc.

As can be seen from the titles the typology does not preserve a purely descriptive character. There is a marked tendency to determine things, albeit it is done by way of adding prefixes which single out specific features of an object. However, both archaeologists of France and other countries are not enthusiastic about the terminological piling up in order to determine a taxonomic unit.

Justice demands to say that F. Bordes makes every effort to coordinate the titles with the principles of morphology. He is looking for the ways of more convincing discrimination of typical and atypical forms of tools. He is trying to turn out terms of accidental origin into the terms meeting the requirements of taxonomy. At the same time he pays no attention to such most important characteristics of tool form as its working part, the way of holding it in the hand, the relation of its weight and size to the hand, etc.

In a series of Mousterian retouch flakes discovered by N. D. Praslov in 1968 on site Nosovo I (near the Azov Sea) parts heavily worn had no retouched edges but juts and angles near the striking platform. Control experiments have shown that such wear must have arisen in working skin although the tools had nothing in common with skin-scrapers. If one takes into consideration the other areas of Europe then the tools of the most unexpected forms and sizes may be included in the category of skin-scrapers whose number will exceed many times the forms presented in the classification of F. Bordes. But even tools discovered in France may give a considerably greater number of skin-scrapers types providing the studying of them is carried out by means of the tracelological method. The real life of palaeolithic man was far richer and far more interesting than the "Procrustean bed" in which it is being fitted by the typological classification.

Let us take the problem of burins in lower and middle palaeolithic times. For F. Bordes⁸ the existence of burins at that time is evidenced by burin facets made on the ends of blades or flakes. Having discovered among findings of the Mousterian site Rozhok I the tools with the traces caused by their use as burins we ceased doubting the antiquity of burins. But the burins had no burin facets. Their working ends were formed by retouch under a definite angle or an appropriate angle on the flake was used. Experiments have convinced us that cutting bone or horn, which had been soaked in water, need not to be done by burins with a facet. On the other hand, "burins" presented by F. Bordes on Table 35, Fig. 1, 2, 5 can't be regarded as burins, although they have some morphological signs of the tools.

Burin facets on the tools 1 and 2 were produced under such angles (exceeding 90°) which allowed using the tools only for scratching but not for cutting. It would be useful for typologists to get a knowledge of the geometry of modern steel burins. There is another reason why the tool no. 5 (burin sur extrémité cassée de biface) is not a burin. Such a tool may be used for scraping. To widen a cut made by a real burin it is absolutely inexpedient, while it is too wide for a cutter⁹. The problem of burins and burin facets is one of the weakest points in typological description of palaeolithic tools. Even upper palaeolithic burins made of prismatic blades were serviceable only if they had their working parts properly formed. In many cases F. Bordes abandons the principle of homogeneity of forms in singling out the types. Among the

⁸ F. Bordes, *Op. cit.* 1961, p. 32, pl. 35, 1-6.

⁹ S. A. Semenov, *Razvitie tekhniki v kamennom veke*. Leningrad 1968, pp. 118-119.

tools "Mousterian cutters" should be mentioned¹⁰. Tools no. 20 and 25 practically have nothing in common. The tool no. 20 can be with the same right related to the type of grooved scrapers (*raclor encoche*). The same ought to be said of pseudomicrocutters (pl. 42, no. 19–20). The tool type "becs burinants alternes"¹¹ (the term which is difficult even to translate into Russian) is utterly incomprehensible. If it had been a serial material, it should have been investigated under microscope for determining its place in the classification. Now it may be described in various ways as one likes.

Sometimes the heaping up of terms intended for precisizing a type makes its understanding more difficult. This is true, for instance, for the type "pointe pseudo-Levallois"¹² whose form will embarrass the most sophisticated typologists. True, F. Bordes accepts the proposed term with reservations.

In describing and naming tools the typology does not differ essentially from the pre-Linné systematic of plants (Theophrast, A. Cesalpino) in which oleander was described as a plant with laurel-shaped leaves and the rose flowers, i. e. one species was being compared with an other and endowed with its characters.

In the typological nomenclature there are singleworded but accidental terms like „limace“ (slug). The term does not express (or does it in a very remote way) even the form of tool. The tools are leaf-shaped in their outline, bulky objects of middle palaeolithic times which are called sometimes "twin points" or scrapers with convexo-concave edges.

In its present form the typology of the palaeolithic even after removing internal inconsistencies and contradictions preserves its artificial character. Its types have been constructed on the basis of heterogeneous accidentally selected characters. Only on a functional basis will it be able to acquire a natural, real character. Tools will be named in accordance with their functions. Polynomial terms abundant now should be replaced by binary ones (composed of two words) or at the most by three-word terms. In the terms, function will be on the first place (chopper, scraper, knife, burin, awl etc.), while the form or any other characteristic will be second. The Russian "roubylo" corresponds to a degree with English "chopper". The category of "chopper" will include the groups of pebble tools worked in various degrees and made of fragments or nodules of flint, quartzite, diorite, obsidian and other rocks. Being described, they are characterized by their material, general form, the form of their working part, sizes and weight, profile, and other signs which previously not always were of interest for typologists.

A radical reform of typological classification created on the basis of French palaeolithic science is necessitated by many causes. Only a small part of French nomenclature is acceptable for the scholars from other countries. Data obtained in the Caucasus, where chalk flint was absent, do evidence how significant are peculiarities of tools of middle palaeolithic times not only in the other continents but in Europe, too. Hundreds of small flint tools, so small that up to twenty of them could be placed on the palm, have been found in the Vorontsov cave which is being dug by V. P. Ljubin for a number of years. Many of them are carefully worked and have traces indicating their use in two or even three functions. It is obvious that the small artefacts were being altered and trimmed over and over again and came to us in unserviceable state. The use of reflex technique shows the repeated altering of tools to be produced in various times by changing inhabitants of the cave. And the form, surface of the reduced products of numerous alterations have nothing in common with initial conception of their first creators.

French typology of palaeolithic tools has been developed on the basis of tools of excellent chalk flint. Such flint was absent in a number of other countries of Europe and Africa; it was nearly completely absent in the enormous Asian continents. This influenced in some degree the morphology of tools despite the fact that the regularities of flaking rocks were the same.

In the typology there are more or less good definitions, e. g. the group of knives of middle palaeolithic

¹⁰ F. Bordes, *Op. cit.* 1961, p. 37, pl. 38, no. 20, 21, 25.

¹¹ F. Bordes, *Op. cit.* 1961, p. 37, pl. 38, no. 24, 39, no. 1, 2, 3.

¹² F. Bordes, *Op. cit.* 1961, p. 23, pl. 13, no. 1–5.

times. This category of tools were singled out correctly, albeit it does not cover all types¹³. The category includes: the knife type with a blunted (retouched) edge, while the other working edge was left without retouch and has a relatively small angle of sharpening; the knife types in which the edge opposite to working part preserves the cortex of nodule or pebbles. In the first and in the second case the blunt edge served for providing a rest for fingers. The knives, to judge by observations and experiments, were used for cutting meat. They could be used for whittling wood only on condition that the angle of sharpening on the working edge was not less 40–50° otherwise the edge would have been damaged and must have been trimmed by retouch. Our data shows that in middle palaeolithic times wood was not only scraped but whittled, too¹⁴.

F. Bordes believes the functions of many prehistoric tools are unknown and will remain enigmatic for a long time¹⁵. The opinion expressed by him nearly 10 years ago appears to be contended up to now. Probably, this explains why F. Bordes did not pay any attention to the most essential thing in the tracological method, viz. to striations on tools as traces of work. Our experiments in manufacturing and using tools of palaeolithic forms have shown the method to be rather fruitful in studying how the old tools were used and how efficient they were, providing their functions are already known. In reality, however, prehistoric man might have fulfilled various works by tools having the same visible form and, vice versa, the tools of various forms might have had the same function, excluding some more or less stable types. We constantly observe it while studying the traces of wear.

In order to study the functions of old tools it is necessary to use such a method which would be based on past knowledge which established beyond any doubt, the facts which would serve as reliable documents. The application of a binocular microscope for many years and elaboration during the time the techniques of metall dusting and coloring the surfaces of objects studied have allowed us to detect the striations due to wear, that is the specific marks of work. It has turned out that the worn parts of tools are covered and crossed in a definite direction by solid or broken lines, or by comet-shaped figures like pointers showing the direction of tool movement during work.

Simultaneously with detecting the signs the question arose whether the striations, the kinematic signs form a kind of system, i. e. such arrangement of traces which could become a key for solving the problems standing before us. Can the traces help us to sort out in a completely objective way the whole diversity of capricious and incomprehensible forms of the oldest tool and to say with certainty: here we have a burin which is different from an awl or drill and it has the signs of wear which differ it from a chisel, or here we have a pestle, rather than hammer and traces of wear on both the tools are different from that of a striker or retoucher. The traces of wear on the axes are different in their outline from that of adzes. In its own turn an adze must not be mistaken for a hoe, while hoes and polishers used in working various materials and different in their kinematics should not be mistaken for one another. Knives (meat, whittling, and reaping ones), saws, sickles, spades, oars, all the tools of stone, bone, horn and shells must have retained the traces of wear and the traces may become etalons for functions, showing the place of the tools in the life of prehistoric man.

Not only observation of old tool and tools from ethnographic collections but also studying contemporary tools and experimenting with stone ones were needed before it became clear that all basic processes of production (piercing, drilling, cutting, sawing, chopping, trimming, whittling, scraping skin or wood, sharpening, digging etc.) have both graphic and plastic expressions in the traces of tool wear, the expressions being specific for each work process.

To sum up concisely regularities of the sort one must say: drilling leaves on the drill circular lines at

¹³ F. Bordes, *Op. cit.* 1961, pl. 35, 36, 37.

¹⁴ S. A. Semenov, *Op. cit.* 1968, p. 104, Fig. 31.

¹⁵ F. Bordes, *Op. cit.* 1961, p. 1.

right angles to its axis; pearcing leaves straight lines parallel to the axis of awl; the traces of sawing are on both faces of a saw and parallel to its working edge; the traces of whittling are unilateral and at right angles to the knife axis, and on meat knives traces run parallel and diagonally on both faces, etc.

Surely, the traces of work were not always clearly pronounced. Sometimes they did not allow to determine with certainty the tools functions. Real investigations not infrequently required new observations, additional tests, and experiments. But one faces this necessity using every technique even the most precise one.

There were many such tools on which it was impossible to detect any traces of wear, although the tools had been undoubtedly used. There was a considerably greater amount of striations on the neolithic tools than on palaeolithic ones. It must be attributed to a more efficient use of flint, bone, and other materials.

In recent years the trancelogical method was improved by using a binocular of Linnik, enabling us to give quantitative estimation of work traces on the old tools. This micrometric innovation was applied, in the first instance, to the stone tools of Mousterian time, whose investigations in the past had been seriously hindered by the very small amount of traces on them. The essential of the micrometric method consists in using the principle of light section presenting the microprofile (i. e. height and depth) of the worn surface of a tool. Comparing the latter with an unworn surface we can calculate accurately (in microns) a micro-relief which suffered changes caused by usage. The data are relevant in measuring the work efforts spent by prehistoric man and determining the functions of tools with non-linear traces of wear.

The elaboration of reflex technique is next in turn. The technique must determine the degree of gloss (in precise units) of polished surface caused by work and other reasons which is of utmost importance in studying tools not preserving line traces. The techniques of studying the functions of the oldest tools by means of microscopes and experiments turned out to be extremely labor consuming. Acquiring habits in the field is rather a slow process and requires from the students specific abilities which hinders the introduction of the methods into archaeology; but every method is in the situation so far as it is being developed by few scientists.

It is difficult for a scholar who trained his mind for distinguishing morphological characters to begin to think in terms of functions and the more so to identify the line trace of work and to determine the functions of tools on this basis. These approaches are so different, just like those of anatomy and physiology with their specific direction and techniques of study. Therefore the functionology of tools of the Stone Age studies the ways of their use in prehistoric economy can not be a simple complement for the morphological studies of their types. It is an independent science expanding our knowledge of the life and activity of prehistoric man, although it must be in a close contact with typology.

One can't agree with the division of typology into morphological and functional ones. Even the term "typology" is not adequate to the term "morphology". In archaeology the "typology" is used in a wider sense. For instance, one can speak not only of the types of single things but also of the types of their complexes (sites, cultures), of the types of economy, of societies etc. In the zoological classification whose principles are better developed the term "type" is referred to the highest category preceded (in an ascending order) by species, genus, family, order and class. The only taxonomic unit above "type" is kingdom.

A concept "functional typology" proposed by F. Bordes can't be accepted. One must deal with typology and functionology as with two quite different approaches to study archaeological data, in the case of palaeolithic tools.

F. Bordes and I also differed in approaching the problem of manufacturing tools. According to my opponent, prehistoric man, while making his bifaces or scrapers, was led by a "conception" of a tool and by the "idea" or image of it. Surely, starting to make a tool, the man had in mind a definite type of the tool known to him not only on the basis of tradition but also on that of available forms. But what was his "conception" when he was altering an existing form or was starting to use it in a different way combining

the functions not foreseen by tradition? This was a living creative process, very often one without any conception behind it but dictated by a moment, by production, by trying and selecting other work movement, by using an other part of his tool.

"Tools" – F. Bordes writes – "may be defined in two different ways: by their use and by their form. These two approaches are often related. It is necessary to distinguish the use intended, foreseen, which often influences the form of tool, from the casual use where the bond of form and function is rather weak. For example, one can drive a nail by using the head of an English key but it will not transform the key into a hammer"¹⁶.

Certainly, there are palaeolithic tools whose forms predetermine function, e. g. end scraper (*grattoir terminal*) for dressing skin. In many countries where the tools can be found, their functions are the same. However, it does not mean skin was worked in palaeolithic times only by end-scrapers. There were other types of scrapers to fulfill the same functions. Some projectile points whose forms completely match their function and the way of their hafting may be pointed out too. But for the diversity of their form I should include in one category awls and drills. There are awls narrow over their entire length, awls made of microblades, as well as awls with sharp ends and wide shoulders, beak-shaped awls, awls having a triangle or square cross section, etc. In Kostenki I and IV we have found awls for piercing used in sewing skins and furs. The awls had the form of tiny grooved points (*pointes à cran*). F. Bordes questions this. He believes them, compared to the neolithic, to be projectile points. His allusions to the neolithic are irrelevant. The ends of awls from the sites are so polished that they have a lustre. They also have striations. All this means they were used for a very long time and many thousands of punctures of skins sewn were done by them.

It is very likely that tools of *chatelperron* types used as meat knives simultaneously served as awls. We could not study the tools by means of the tracological method. But the evidences available for us in the USSR have shown a wide variety of meat knife forms. The knives were: blunted made of prismatic blades (Kostenki I), made of short blades (Malta), different in their form blades or flakes from various sites of upper palaeolithic. Of special interest is a big knife of white slabbed flint discovered by W. J. Kaniwets together with bone remnants of 20 mammoths at the late palaeolithic site of *Byzovaja* in the lower section of the Pechora. Our experiments carried out on the Caucasus near Sukhumi have shown that cutting up animals can be produced by the most different flint flakes or blades with respect to their form and size, providing the angle of sharpening them does not exceed some optimal value.

F. Bordes points out rightly the occasional functions of some tools which could not be used systematically and for a long time. But, unfortunately, typology can not conclusively show which tool was used by prehistoric man in an occasional and which in a systematical way. To do this one must study the traces of wear while the duration of using the tools will be mirrored in the intensity of the traces. A long duration will indicate the systematic character of such use.

We agree with F. Bordes that the weak point of typology is its incapacity to find out what is significant and what is not in a tool. The typologist is very often flooded with details not knowing what he must pay attention to. Above all the typologist very often is not sure what precisely he must take for a leading form which is peculiar for a culture. As for the quantity of characteristic things and dominating types it is not known whether it is possible always to be guided by the consideration.

The main objection against overestimation of archaeological statistics is that archaeology has to deal only with a small fraction of things existing in prehistoric times. These are only a fraction of an unknown relation. Even the most stable stone artefacts, the flint tools of palaeolithic times were being destroyed on the surface by the discomposing action of sunlight, loosing his composition, and disappearing completely.

¹⁶ F. Bordes, *Op. cit.* 1967, p. 25.

There is an opinion that in the cave sites stone tools are being preserved better both in quality and in quantity. It is true, to a degree. On open sites after people had left them having taken all of value, things remaining disappeared due to various causes. They were kicked away by the hoofs of the herds of wild animals, carried into holes by moles, picked up by passing hunters and by inhabitants of other areas, were washed off by spring and rain waters into ravines or stream beds where they were being ground among pebbles and gravel. Only an insignificant part of them were tramped down into the soil and could be preserved under a protective earth layer providing the layer was not subjected to destructive actions of geologic processes in the millennia to come.

Stone tools preserved in the cultural layer of cave sites, surely, might have avoided destructive action of such natural factors as water, animals, and even geological processes. But caves and rock shelters always attract the attention of man. They might have been used not only as long-term dwellings, which is evidenced by multilayer sites of this kind, but as a short-term shelter for people of various ages. Each flake, remnants of tools, each piece of flint found in the surface layer of a cave floor was of value for the man of many epochs of the Stone Age. We know it on the basis of data obtained among Australian aborigines. That is why things which for some reasons had been useless for previous cave inhabitants and left by them were picked up by subsequent dwellers. Studying the surfaces of Mousterian tools by reflex technique has shown the multiple use of the tools left by the new inhabitants of caves.

There are good reasons to believe that insignificant remnants of things which are being preserved in the cave sites and can be found by archaeologists, do not represent the quantity of things used by previous inhabitants of the place. The remnants also can not represent real quantitative relations between various categories of objects (tools, prepared flakes, waste etc.) and their various types. Spear points, ripping knives etc., the most important tools of palaeolithic hunters, as a rule, were lost during hunting in the very moment of their using. Nearly each strike with a spear, irrespectively whether it was successful or not might have costed the hunter a stone point due to its brittleness. A hunter for 10 years of his hunting activity must have spent thousands of points while on the site, as it might happen, there were few or even none of them. From ethnographic evidences we know the points for javelins not infrequently were made during a hunting expedition from the stock of prepared flakes taken with, or from materials found in the stream beds.

Ideas of archaeologists based on the figures of available remnants of the material production are ideas about what had been found rather than about what had really existed in the past. The data allow us to study the technological levels, to estimate the characteristics of economic activity, to elucidate some peculiarities in the ways of working stone and to raise other problems of the reconstruction of various sides of the life and environment of the prehistoric man. Statistics may be of use here but it plays only a humble and minor role. Based on its indices one can speak only of the predominance of some methods of working, some materials, tool types and of the existence of some trends in the development of technological skills, etc. But even the conclusions will be of scientific value only if the historical problems are sensibly formulated, the content and task of investigation are precisely determined, scientific apparatus is ordered and terminology is codified.

The proponents of the typological method, who believe statistical treatment of data of flint tools strengthens the method, disregard one very important scientific rule: form and content of knowledge must be in an equilibrium. The rule is even more compulsory in the field of history. If the form of science, i. e. its logical-mathematical symbolism, dominates over the real content of historical process, it is being turned out from the mode of making scientific concepts precise into the mode of making them confused. Only the unity of form and content of knowledge grants the advance of science.

F. Bordes blames some typologists dealing with the hopelessly entangled problem of Perigordian in terms of the widely accepted scheme: "This came from Perigordian IV as we have here a Gravette (disregarding

all other tools) while the Gravette is here because it is Perigordian IV"¹⁷. He calls this way of thinking "instant conception", forgetting that such primitive mode of typological reasoning has only slight differences from the most perfect typology when it tries to decide historical problems. Exactly the problem of the Perigordian shows clearly the impotence of the typological method to gain an understanding, even chronologically of the upper palaeolithic, to say nothing of other problems. Some authors, including D. Peyrony, advocate the independence of Perigordian and Aurignacian, although the two cultures existed simultaneously and in a close neighbourhood. Previously the two cultures were being considered as two stages of the same culture. Now however, the hypotheses of the autochthon origin of Perigordian are being confronted with the same number of hypotheses of its foreign origin. And there are disagreements with regard to the invasion of Aurignacian in the territory of palaeolithic France. Some authors advocate that there was a contact between Perigordian and Aurignacian, while others deny it. F. Bordes believes France in late palaeolithic times, to be "a desert swarming with animals" where hunters of the Perigordian and Aurignacian were not interested in each other for millennia (p. 66). Still there are disputes whether Chatelperronian and Gravettian, the two stages ("industries") of Perigordian, are independent or related to each other. F. Bordes is convinced that some dark points of the problem have been solved. At the same time he complains of the fact that the large rich sites of France having great value, remain uninvestigated by means of new techniques, such as the method of analysis of pollen and the isotope C¹⁴ technique. We agree with the complaints. Only the use of more sophisticated techniques may lead to disentangling the strongly tied knot. But then it will not be put down to the typologist's credit.

What are the strong and weak points of the typological method? It is extremely important to consider briefly the problem from a new point of view. Let us begin from a short historiographic introduction.

The typological method has been developing since 1870 in the works of O. Montelius and H. Hildebrand who independently of each other but under the influence of the theory of evolution which was being formed at that time, started their investigations of the archaeological sites of Scandinavia. They focused their attention on the so-called "prehistoric epochs" – neolithic and early metallic –, whose studying at that time was still in an embryonic state. Somewhat earlier attempts to develop a typology were undertaken in England by G. Evans and L. Fox, G. Dechelette in France, S. Müller in Denmark and other archaeologists worked in the same direction. The works of H. Hildebrand (1806–1884) did not exert a great influence on the archaeology of prehistoric ages as he very soon left "prehistory" and concentrated his attention on studying the Middle Ages.

O. Montelius (1843–1917) maintained the direction of investigations started by him earlier and created the science which gained a wide recognition¹⁸. The main task set by Montelius consisted in developing a method which would allow one to set up a reliable chronology for a large period of history where written sources are absent. He proposed the chronological classification of the archaeological evidences of neolithic, bronze, and early iron ages. The classification was constructed mainly on the data of Northern Europe. He showed that ancient things could be divided into the groups in accordance with their material, form and function.

The typological classification of things was accompanied by their comparative analysis and by establishing synchronous series of the elements on the basis of their joint association. This allowed one to assert that such-and-such a series of tools were accompanied by the synchronously given series of decorations, vessels, and other items. As a result of it, archaeology has received a basis for the chronological determining of things and for establishing the sequence of their evolution. The essential result of the typological investigations of archaeological data consisted in confirming the noted earlier law of succession in the development of things according to which their changes are closely genetically connected,

¹⁷ F. Bordes, *La question périgordienne. La Préhistoire. Problèmes et Tendances*. Paris 1968, p. 62.

¹⁸ O. Montelius, *Die älteren Kulturperioden im Orient und in Europa. I. Die Methode*. Stockholm 1903.

while evolving things maintain some features of earlier form and this allows one to arrange all the things into a single evolutionary series.

The law of succession was applied to nearly all things created by man. O. Montelius pointed out that there is a typological connection between the first railway carriages and antecedent mail-coaches. – The law of succession had such common features with the laws of organic evolution that O. Montelius considered it possible to identify them. “The development may be slow or quick”, – he wrote –, “however, the man creating new forms always must comply with the same law of evolution which holds good for the rest of nature”¹⁹.

The typological method advanced by O. Montelius was further applied and developed by his disciples and followers. N. Åberg continued to elaborate further on the main principles of the method, and to seek its connections with the methods of natural sciences with those, for example, accepted in biology.

N. Åberg wrote: “Typology is an application of Darwinism to the field of human work products. It starts from the premise according to which human will is bound by certain laws analogous to those acting in the evolution of organic nature. Antiquities undergo an evolution as if they were living organisms, single things are individuals, a typical series represents the development of a species, while the group of a typical series producing the ramification of various lines represents a family.”²⁰

Thus, archaeological data are arranged in the form of a genealogic tree. As in biology, where one comes from a pre-organism, the types and groups of objects of prehistoric times can be traced up to their original pre-objects. Giving a general appraisal of the typological method N. Åberg maintained that the method contributed to the transformation of prehistoric archaeology into a science. Earlier archaeological data were treated approximately in the same way as stamp collectors treat their albums. “The new method teaches us to read in the data the life of prehistoric times; the data speak of various peoples and their changing relations, of the places of their settlements, their migrations and wars, of their peaceful relations and the development of their material and spiritual culture.”²¹

It was quite natural that successes of Darwinism influenced greatly the formation of the typological method in the young branch of historical knowledge striving to take the path of a positive science. However, in spite of the fact that the typological method was applied very widely in all countries its theoretical elaboration did not advance significantly, that is, did not overcome its previous stage of biological evolutionism. Even its founders were conscious, to a degree, of the numerous shortcomings of Darwinism when the latter is applied to human history, and tried to justify themselves.

Archaeological objects, as was stated further by N. Åberg, are dead things and therefore can't evolve spontaneously. Their changes are caused by the “will of their creator”. The idea of creative will took N. Åberg far away, led him to a metaphysical thicket of the “spirit” and “will” of ancient northern peoples whom due to their creativity a special place should be granted. Later on N. Åberg put forward the new characteristics of the method which contradicted the previous positive appraisal. They were caused by numerous critical attacks of the archaeologists from different countries. The attacks were due to failures and errors in the method application. “The typological method” – N. Åberg wrote – “is not a method in a strict sense. It can't be learned like a school subject. On the contrary, it can be compared with an artistic penetration. The typologist's work is guided by instinct rather than consciousness. He enjoys the rhythm of development like a musician, and he reacts upon a false typology just like a musician reacts upon a false note”²².

The ultimate aim of typological investigations, according to O. Montelius and N. Åberg, is to establish the

¹⁹ O. Montelius, *Op. cit.* 1903, S. 20.

²⁰ N. Åberg, *Typologie (Typologische Methode)*, M. Ebert, *Reallexikon der Vorgeschichte*. Bd. XIII, 1929, S. 508.

²¹ N. Åberg, *Op. cit.* S. 508.

²² N. Åberg, *Op. cit.* S. 514.

psychic properties of peoples mirrored in archaeological evidences. The evidences demonstrate great differences in the rates of development of European and Oriental peoples. Even in Europe the same differences are seen. The types of things which were undergoing intensive changes in Scandinavia or Germany did not reveal any significant changes for centuries in the East Baltic countries which reacted as if they were frozen. On the other hand, comparing the artefacts of the Northern Prehistoric Europe with those of Southern Europe one can see that some conservatism and inertness in conjunction with persistence and strong will are peculiar for the formers while an excessive variability, the lightness and playfulness of temperament for the latter.

“If one compares Europe with the Orient“ – O. Montelius pointed out – “from a typological point of view, he will find in our continent much greater animation than in the Orient. In Europe one meets with a wide range of forms, mobility, the love and preferences of changes which is equivalent to practical innovations and, as a result, with a rapid development opposed to the conservative Orient, where an old form can remain in the same state for centuries”²³.

Certainly, archaeologists of our days, particularly those studying the palaeolithic, do not make such conclusions in their scientific works. From the typological method of its creators they took only its principle – the law of succession based on the morphological changes of things in the course of history, on comparing and correlating forms, on singling out similar characteristics and differences and on searching ancestors.

It is appropriate to raise the question: is it rightful to use the law of succession as a basic tool for archaeological investigation, knowing that it has led its creators and their disciples (G. Kossina a. o.) to the division of tribes and peoples into different categories, into active and passive, creative and receptive ones? The typological method so far sets a task to divide all the relics of antiquity into closed complexes (cultures) belonging to some tribes in the past. Such direction of investigation would be feasible if the law of succession corresponded in all its details to the law of organic evolution, as it were supposed by O. Montelius and N. Åberg. But such a correspondence does not exist in spite of the seeming closeness of the laws.

Now, when a great amount of archaeological data has been collected and conditions for dividing it into cultures and arranging the data in a genealogic succession have been apparently created, the material does not lend itself to cognition from the previous point of view, by old techniques. The revealed lines of successive development of things very often are interrupted by the intrusion of objects having alien features. It happens sometimes that cultural layers during excavation of multilayered sites are chronologically “upside down” when the most primitive and earliest forms lie above advanced and late ones. The number of “cultures”, i. e. the complexes of things related to certain (sought for) ethnic communities of people (pretribes and tribes) in incessantly growing. The searches for ancestral forms of types and cultures are taking a discussive character.

The difference between the evolution of living organisms and that of the products of human labour is the principal difference of biological and social processes. So far the difference is not completely elucidated by science. But something can be said of it now.

The development of organisms follows the laws of morphogenesis. The development of tools and other artefacts follows the laws of constructive changes, transformation where an important part is played by thought though not always. The changes of objects may take place in a short time. The man may change his tool not only after a year or a month of work with it, but having noticed its defects the man may change it after an hour of work. He may remake it long before starting his work. Depending on the requirements of moment the man is ready to transform a scraper into a knife or a knife into a scraper, a burin

²³ O. Montelius, *Op. cit.* 1903, pp. 20–21.

into an awl, a point into a knife, a hammer into a pestle, etc. He can make two or three tools of one or to combine two or three tools into one. Such transformations of organisms are impossible.

An organic evolution is basically linear. Organisms are originated by organisms along definite phyletic lines by means of reproduction. Interlacing the lines of various species via random hybridization does not give viable posterity. Variability through the inheritance of new characters is a slow process under natural conditions. The way of species changes is a sex contact, while the factor of variability is a natural selection under definite environmental conditions.

One of the most peculiar characteristics of the origin of species consists in the fact that each of them appears only once in the history of an organic world. Its development is accompanied by the appearance of varieties, the latter being only the forms in which the given species exists. Intermediate forms in the world of plant and animal species have not been found. The process of species formation goes in the direction of divergence while the reverse direction (convergence) does not exist.

The development of the objects of material culture occurred and occurs by way of syncretism through the cooperation of productive efforts of various people, by means of both direct contacts and without them. All significant advances of the material culture of the Stone Age (hand-axes [bifaces], Levallois knives, spear points, prismatic blades, spear-thrower, bow and arrows, harpoons, ground axes, ceramics etc.) were realized and developed by the efforts of many tribes.

After investigating palaeolithic sites for many years H. Breuil was compelled to admit this although this new idea was not developed neither by him, nor by his disciples.

“The time has passed” – H. Breuil wrote – “when it was possible to dream of a simplified evolution, having an inherent unity, the evolution where each phase would grow from the same soil of a previous epoch and would produce the next phase from itself. Investigations are growing incessantly, evidences are coming to us from more and more remote areas and we can notice both marked analogies and differences in the development of things. It becomes obvious that what we once took for a continuous series, for a local evolution of the same population, is in reality a result of the cooperation of many tribes influencing more or less each other either by exchange, or by the infiltrations of products, or through the sudden invasion of bellicose strangers”²⁴.

The stability of the species characteristics inherited by organisms from their ancestors and the preservation of species as a basic taxonomic group, its inability of crossing with the organisms of other species all these living body properties are of vital importance. Just thanks to the conservatism and segregation of vegetable and animal species these could adapt in a most effective way to the conditions of certain environments, such as climatic, water, and soil peculiarities of their surrounding nature. Without such properties organisms would be doomed to extinct. While crossing with the other neighbouring species they would be losing their ability to inherit the effective characters of their ancestors, getting maladapted to both types of natural conditions.

Different forces and tendencies act in the human society. The development of tools has multilineal and convergent character and is realized through the complicated interactions of various types in the process of syncretism. The type of tool may be repeated several times arising in different countries under the influence of similar conditions, materials, or similar ways of production and work. Due to the extreme variability of all products of human labour numerous intermediate forms are constantly arising in between the various types of tools. The rates of transforming types, the variability of things in man's hands have quite a different character emphasizing that rates and modes of movement of objects in the cultural environment and historical process are basically new.

²⁴ H. Breuil, *Les subdivisions de paléolithique supérieur et leur signification*. Congrès International d'Anthropologie et d'Archéologie Préhistoriques. Genève 1912, (1937), p. 169.

A syncretic character of tools and artefacts was determined not only by their being the products of cooperation of the representatives of various tribes and countries but also their being a result of the inter- and intragroup division of labour. If we take into account great differences of the quality of manufacturing things we must conclude craftsmanship, high skill in producing things should have appeared very early, perhaps in the middle palaeolithic. Later on, to judge by the data of Australian stone working technique²⁵ which can be compared with the techniques of the palaeolithic and neolithic, as well as by the evidences of experimental manufacturing of prismatic blades requiring highly specialized habits, the division of labour also played an important part.

A usual exchange of artefacts, when producers got into a direct contact was one of the earliest form of cooperation. B. Roth, D. Thomson and F. McCarthy report on the wide exchange of products among the aborigines of Australia. These products are: ground axes, knives (leilira), spear points, grain mortars, pestles etc. Not infrequently objects exchanged made long journeys crossing the whole continent²⁶. The exchange of produced tools was caused by the availability of good raw materials (diorit, flint, quartz, sandstone) in one region and their absence in an other. Sometimes raw material itself was exchanged, but more often the tribes possessing needed stone were specializing in manufacturing tools and preferred to exchange the tools for the things they needed.

There were special centers in which the exchange operations took place and where the representatives of exchanging tribes came to. However, more often the centers were not neutral points but the places where raw materials were available and artefacts were being produced. Such an inter-tribal division of labour was determined by the nonuniformity of geographical conditions: not all economical needs could be satisfied on the basis of available resources. Some tribes had good abrasive materials and materials for manufacturing grain mortars, but they had no flint or quartzite, while the others had a great stock of technical wood but they had no raw material for manufacturing ground axes, etc.

Exchange operations among the Australians were not limited only by the products of the material goods production but covered also the realm of spiritual culture such as customs, rituals, dances, games which were being passed from one tribe to another. "Thus, exchange was a significant factor in levelling the Australian culture and in creating a cultural similarity over vast territories if not over the whole continent."²⁷

What forms might represent a contactless cooperation (H. Breuil calls it "infiltration")? During lower and middle palaeolithic times the various forms of cooperations among hunting groups might have taken place when the number of direct contacts was small or even equal to zero. There are no reasons to believe that our ancestors in very remote epochs existed under conditions of complete isolation. Even among ungregarious animals (carnivora) periodical contacts take place mainly on the basis of seasonal sexual intercourse. In lower and middle palaeolithic times the contacts of hunting groups were possible both on the basis of sex relations and in the cases of the extinction of hearth fire whose producing artificially was, as we believe, unknown. Fire was obtained from natural sources (volcanos, heath and forest fires, spontaneous ignition) and maintained in the hearths. Contacts based on borrowing fire were the most probable form of intercourse, which if we take it as a sociological phenomenon, played not an insignificant part in the process of the sapienization of our ancestors. Intergroup relations of such a kind did not require any sacrifices or privations leading to conflicts as coal, smouldering branches cost nothing to the owners of fire. Ethnography does not give us the evidences of human hostility due to this cause.

²⁵ V. R. K a b o , Kamennyi orudja avstaliitsev. Trudy Instituta Etnographii im. N. N. Miklucho-Maklaja, nov. ser. t. I, XXX, M.-L., 1962, p. 80.

²⁶ F. D. M c C a r t h y , "Trade" in aboriginal Australia, and "trade" relationships with Torres Strait, New Guinea and Malaya. Oceania, vol. 9, 1939, no. 4, vol. 10, no. 1-2.

²⁷ Narody mira. Narody Australii i Oceanii. M., 1956, p. 205.

Under the category of contactless cooperation falls visiting sites left by one group by the representatives of other hunting groups during their migration, as it is observed among the pygmies of the Equatorial Africa, Bushmen and Australians. Everything left on the sites by the first ones was of interest for the newcomers. The remnants of hearths fragments of stone, bone, wood and horn artefacts attracted attention and were the objects of evaluation. Such "visits" not infrequently were made in looking for the remains of food.

The infiltration taken in a strict sense of the word was presented by "a stage exchange" which existed probably already in palaeolithic times. In Australia artefacts produced in the North of the continent, e. g. in Arnhamland travelled through the country to the South (Victoria or the New-South-Wales). They were passed from hand to hand and so they were being moved through the whole continent from one tribe to another²⁸. The travelling ways of things passed along the great rivers (Darling, Murrey), sea-coasts, and even through desert areas. A "dumb" exchange was another way of contactless cooperation. This form of exchange was practised by tribes which were hostile to each other. Having left their products in the conventional places they left the area for the time being. Their antagonists took the objects left and put in exchange their own products, leaving the place in their own turn. The existence of "dumb" exchange evidences the fact that economical relations often were a factor independent from political relations and situations. Exigencies of life dictated the norms of conduct and the exchange of products of vital importance were not interrupted.

The systematic intertribal exchange of artefacts does not mean, of course, that specific artefacts, the special ways of work, peculiar tastes, some peculiarities of form and trimming of tools did not exist in various tribes. B. Spencer points out that the proprietors of such other-tribe artefacts did not try in their own work to reproduce their forms even if all needed material was available. Tribe artisans made things in their own way²⁹.

The stability of technological traditions of backward peoples gave occasion for some investigators to assert mystic fear of all new, a religious conservatism on low levels of cultural development. L. Lévy-Bruhl wrote: "We have here the direct result of faith to the mystical properties of objects bound up with their forms. One can master the properties by means of a definite form. But they will escape the control of man, if he changes even the slightest detail in the form. The most insignificant innovations are dangerous, as they may release hostile forces and be destructive for the innovator and to all who are related to him"³⁰.

The conservatism of forms of things produced by prehistoric man is strongly exaggerated here. Australologists express also opposite opinions on the problem.

B. Allchin wrote: "... their economic structure is both complex and diverse. The same group of hunters being occupied by various activities may produce five or six very different sets of tools during a year." – "It happens" – the same author continues –, "the tool of the same type may be hafted by various ways and have different functions not only in the various parts of a continent but also for the same person ... and vice versa the most various tools may have the same function"³¹.

It is possible that the author goes from one extreme to another exaggerating the variability of tools and the ways of work. But if such modifications are taken in a smaller scale they will be convincing enough. One must remember the observations of tribal life carried on by ethnographers cover too small a time interval (tens of years) for them to serve as evidences of the slow rates of changing things in palaeolithic times.

²⁸ B. Allchin, Australian stone industries past and present. The Journal of the Royal Anthropol. Inst. of Great Britain and Ireland. Vol. 87, part I, 1957, London, p. 118.

²⁹ B. Spencer, Wanderings in wild Australia, vol II, London 1928, p. 496.

³⁰ L. Lévy-Bruhl, Pervobytnoe myshlenie. M., 1930, p. 24.

³¹ B. Allchin, Op. cit. 1957, p. 134.

One must pay attention to two quite different types of changes existing in the developments of products of human labour, which are usually confused by typologists.

As distinct from progressive changes of tools and other things, which mark the epochs of history and which are a result of summing up minor changes, there is quite a different type of changes. These changes occur much quicker in short intervals, though they do not create epochs nor do they contribute greatly to life and culture. The changes are called the modification of things (from latin "modificatio"). In biology this term refers to the deviations of organisms from parent forms which can't be inherited. The modifications of things are different as objects undergoing modifications may exist for some time, may be reproduced, repeated, passed to other tribes and peoples and may transfer from one generation to another.

The modifications of artefacts are various deviations from definite features of their prototype. For example, Mousterian scrapers and points taken in their classical form may be varied in their material, size, width, length, thickness, outlines, symmetry or the angle of blade sharpness. Spear and projectile points are variable in the same degree. If trapezoid microlithic projectile points had not been found attached to shafts in a transverse position on the mesolithic sites of Denmark, such way of their use would not have been guessed. There are known cases of using analogous forms in the neolithic but having larger sizes in the capacity of a chisel.

The deviations from a prototype may be so great that deviant scrapers and points will form special types, though their functions will remain the same. Tracelological studies of evidences discovered on the late-palaeolithic site Timonovka have shown that alongside the end scrapers, scrapers made of flakes of various forms (nearly oval, trapezoid, triangle) served as tools for dressing skin. Not lesser variety of scraper forms have been discovered in the palaeolithic site of Malta and in other sites of the same ages. The burins from the sites of Timonovka and Suponevo were divided by V. A. Gorodtsov into 75 types in accordance with their form. If the modification of the tool, on one or two sites having a definite function is so great, then the variability of form, material and sizes taken in the framework of the whole epoch or even its part reaches the degree of contrasts.

Bronze axes discovered on a relatively small territory of BRD and DDR³² revealed the variability of both the general form of their cutting edge, and the form of the butt, length and the character of edge rigidity. Some variants have acquired the outlines of blades, daggers, fans, quadrangles etc.

What are the reasons for the modification of artifacts? On the one hand, a prehistoric hunter, traveling from one place to another, even in the boundaries of a limited area, met various conditions of life and found various materials (wood, stone, bone, horn). Therefore, he was compelled to change the tools and other needed things. On the other hand, man can not use a tool or any thing in the same form or way for a long time even if materials remain the same, otherwise any development, including a slow one, any change necessary for every form of life activity would stop.

Changes in various areas of our life and activity are caused by the action of the same factors. We change colours, qualities, styles of dress, foot-wear and coiffures in accordance with fashion whose laws are still unknown for us. We replace one piece of furniture with another, change the composition of our food, gain new friends and lose old ones or establish new relations with them. Many factors are involved in the process including aesthetic ones which exert great influence on the changes of form sometimes even to the detriment of expediency.

Typologists who divided things produced by man into types, and the complexes into cultures, believe that isolated groups of people in ancient times might have produced completely identical things not being influenced by their neighbours who manufactured the things in a different way. They persistently maintain that if cultures are genetically related, arising one from other, their interaction is impossible. Al-

³² A. Lissauer, Erster Bericht über die Tätigkeit der von der Deutschen anthropologischen Gesellschaft gewählten Kommission für prähistorische Typenkarten. Zeitschrift für Ethnologie 36, Berlin 1904, 537.

though intermediate cultures, the products of reciprocal contacts of two or several various cultures, are not excluded theoretically. They do not meet the requirements of genealogy of their creators.

The syncretic character of the development of things caused by cultural exchange, which arouse with human labour and played an ever-growing part, corresponds with the general regularities of social and historical process. Unlike the animal or vegetable kingdom where the process of evolution goes in the direction of species divergence or segregation the evolution of human society goes in the opposite direction. Small isolated groups of hunter-gatherers of lower palaeolithic times gradually gave rise to pre-tribe and tribe associations, the development of which with the emergence of the new type of economics (agriculture and stable settlements) was concluded by the rise of class states. It goes without saying that the process has a dialectic character. The uniting of tribes was realized in two ways: cultural-economical and military-political ones. The tendency to the congregation of human society should have arisen together with anthropogenesis otherwise we could not realize the process, viz. we could not understand why on the lowest levels of development, when isolating influences of physico-geographical factors were so great, the mankind continued to maintain its species unity (Fig. 1, I-II).

Formal-typological method in archaeology is not something unexpected and unique. It is a completely legitimate stage in the development of science, one of the first approaches to studying facts. Other branches of knowledge have passed through the stage, too.

In zoology one of the outstanding representatives of the typological investigation of organisms was J. Cuvier. Despite all his achievements he remained on the position of denying the development and variability of species giving only morphological characteristics of animal types united into a system. His adherents also either completely rejected the idea of evolution or reduced it to macromutations³³. The difference between the typologists in zoology in the early XIXth and typologists in contemporary archaeology consists in that the latter do not deny the evolution of things produced by man and study carefully their variability from one epoch to another. But they consider the changes as a linear variability ignoring the mode of object variability which is called in selection "cross hybridisation". The term should be used with some reservations when one deals with changes of things produced by man. The types of things are being considered by typologists in capacity of some abstract taxonomic units. They are not being related to their functions in economical activity of the man and are being considered as objects spontaneously developed. Such a conception necessarily, against the typologist's will results in the absolutization of types.

Even when the idea of evolution triumphed in zoology many zoologists remained on positions of morphologism and formalism. Just like contemporary typologists striving to unite all "cultures" into long genealogical chains the evolutionists advocating monophyletism tried for a long time "to detect in the evolution of animals a continuous line of gradual changes which led from the lowest to the most complicated forms"³⁴. Systematic searches for transitional forms between ctenophora and coelenterata were undertaken, annelida through perypatas were related to arthropoda, vertebrata were inferred from annelides. The embryological and comparative-anatomical attempts to unite the most different and very remote groups of animals have failed in spite of an enormous amount of data called to prove the monophyletic idea.

In organic chemistry the theory of types was founded by C. Gerard. The theory reduced complex processes to simple reactions ("types") which could be described and accepted empirically without going into the essence of a process, without considering the atomic structure of matter.

The scientific typology in the beginning of XIX century arose under the influence of speculative doctrines of naturphilosophers (F. Schelling, L. Oken, J. Karus and others) while its sources go back to the philosophy of Plato whose "ideas" had laid the foundations of scientific formal-typological thinking.

While the doctrines of typologists both in zoology and in chemistry were considerably advanced in

³³ E. Mair, E. Linsley, P. Jousinger. "Metody i principy Zoologicheskoi sistematiki". M. 1966, p. 27-28-267.

³⁴ N. A. Livanov, Puti evolutsii zhivotnogo mira. M. 1955, p. 375.

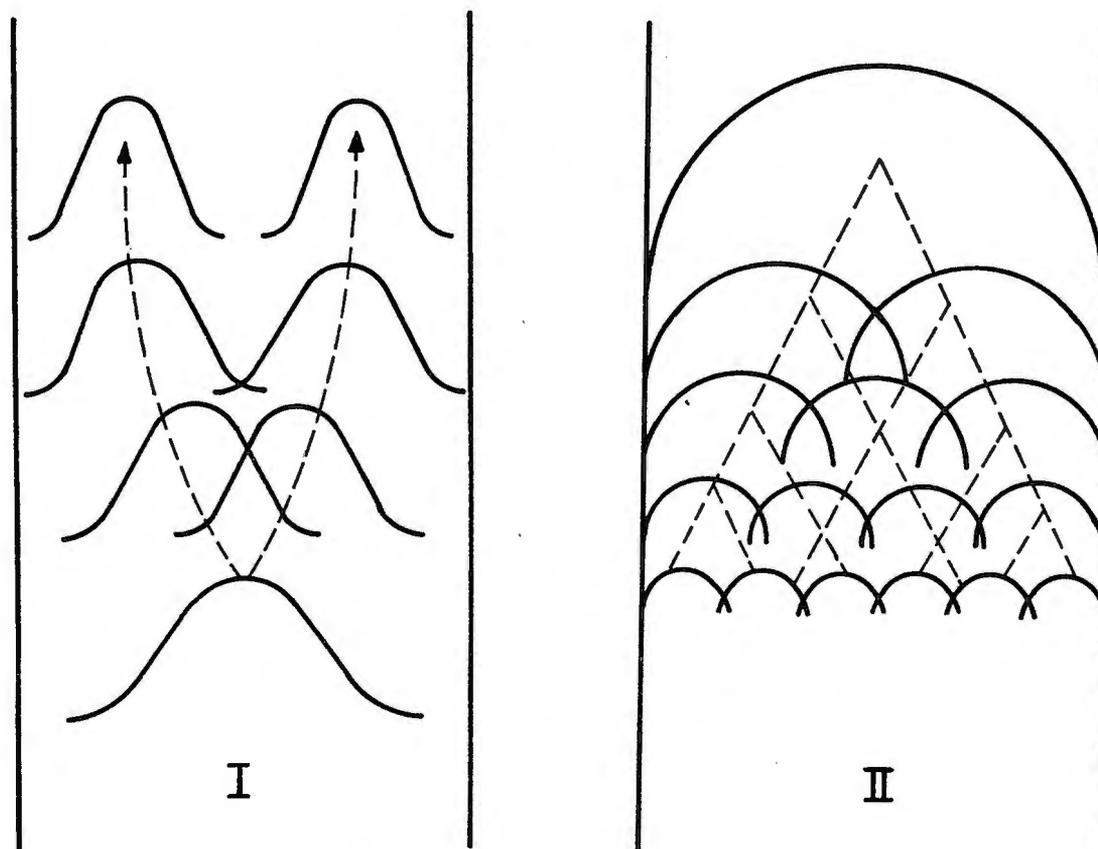


Fig. 1: Development – Biological and Social.

I. Divergence of species (after Simpson).

II. Rapprochement of cultures and human societies integration.

comparison with uncoordinated empirical knowledge of their forerunners, the attempts to create a scientific system, nevertheless were founded not so much on experimental data as on speculative principles. It could not but hinder the progress of science. The way out of typology in zoology gave the theory of population and recognized the variability of species in the population. Alongside of this the concept "type" acquired a basically new content. Typology in organic chemistry was overcome by A. M. Butlerov's theory which is based on the principle of unity of qualitative and quantitative changes in the molecule construction, on recognizing the interaction between atoms and molecules in a chemical process³⁵.

If we turn to the system of geological sciences which deal with the structure, composition, and history of the Earth's crust we shall find nearly the same course of the development: from purely formal description, definition, and classification of the facts to a deeper penetration into their internal properties and processes by application of new methods. Thus, for instance in mineralogy at the end of last century, the narrow and abstract limits of the crystallographic school (or "crystallographic scholastic" as it was referred to) were broken and the science entered the wide way of crystallochemical, thermodynamic, roentgenographic, microoptic, etc. investigations. The great successes in mineralogy in this way allowed it not only

³⁵ B. M. Kedrov, *Borba A. M. Butlerova protiv idealizma, agnostizisma i mehanizisma v organicheskoj khimii* XIX v. *Filosofskie voprosy sovremennoj fiziki*. M. 1952, p. 541–575.

to rise significantly its theoretical level, but to prove its practical usefulness in mining, metallurgy, treatment of mineral resources and other spheres of production³⁶.

Our opponent has ended his critical article by a witty example, which, as he believes, can in the best way define the part played by typology in the science. He considers studying the technology and functions of palaeolithic tools to be a subsidiary in settling the important historical problem: by whom the tools have been made.

So, future historians collecting the remnants of cars will ask what firms has made them: Fiat, Citroen, Volkswagen, Ford? Let us imagine for a minute that archaeologists of the XXI century have collected all the remnants of cars from the automobile of Benz of 1888 up to the last models of Fiat, Renault, and other firms of Europe. What, in the first place, will be of interest for a typologist-morphologist in the mountains of metallic debris? The trade mark of producers? But if the trade mark is absent he will study the forms of car bodies, wheels, the capacity of luggage-compartment, the types of traffic lights, seats, the arrangement of steering devices etc. in order to define the character of a model and then to establish the names of the producers, providing their names have been preserved in annales. But if not ... Reconstructing the types of models, he will give them conventional names, just like typologists who try to single out "prehistoric cultures".

However, it is well known that the car models of mass production are only a small fraction of models which were produced and rejected by a firm, whose production was stopped or did not reach the stage of an assembly belt. Hence, some important links in the development of a car model will not be taken into account by a typologist-morphologist. The difficulties will be augmented because the car industry is subjected to the influence of fashion whose caprices incessantly interrupt the logic of the development of a car as a mode of transportation. F. Bordes may agree with us or not, but it is beyond any doubt that if typologists limit themselves only by studying the morphology in the car development and ignore its main functions (the power of motor, speed, the system of supply, lubrication, ignition, amortisation, brakes, electrotechnical devices etc.) their work will be on the same level as the work of peoples collecting the boxes of matches or cigarette packages.

Our critical evaluation of the typological method does not imply that we are striving to replace it by other methods. All its defects do not hinder it to occupy a firm position in science. It is a way of describing and of the primary classification of things. The law of succession with essential corrections and reservations limiting its importance for archaeology will remain in the arsenal of the science, providing that its application is recognized as fruitful only in limited territories, in a narrow circle of unambiguous sites and its conclusions can be verified by other means. A large part of existing nomenclature, if not only French terms are taken, can be preserved even in the case of reconstructing the principles of systematics. There are no reasons for radical revising of traditional problems. The growing use of new methods in archaeology may widen its possibilities to such an extent that problems which appeared unsolvable before unexpectedly will find their solutions while hopeless ones will die by themselves. But the archaeology of the palaeolithic must not limit itself to typological studies. It must know what the oldest tools were made for and how they were used by man. Science needs an increasingly fuller reconstruction of the life of our oldest ancestors. And typologists who are the monopolists in archaeology should not meet new ideas which do not completely agree with their opinions, with such suspicion and hostility as it was done by F. Bordes. There are only few functionologists in studying the palaeolithic while typologists are counted by legions and for the present they should not be worried about their fate.

³⁶ A. Betekhtin, *Mineralogia*, M. 1950, pp. 10-25.