Example of essay on origins of tools

Technology, Development

The main stages of the development can be defined in the following order: simple tools, accumulation of tools, sophisticated tools; the actuation of the complex tools by single engine - human hands, bringing these tools into action by the forces of nature; machine; system of machines having one motor; the machine system having automatic engine.

The first four stages of the given periodization received their formation in the primitive period. A simple instrument that has no component parts, appeared millennia before our era, in the early period of the Stone Age (Paleolithic) as a hammer - piece of pebble that by cleaving gained shape, which is easy to reach by fingers. Later, from the same pebble by cleaving were manufactured better tools with cutting edges and sharp points, arrowheads and spears, flint knives and scrapers (see Fig. 1).

Apart from flint, a material for tools was also wood, bone, out of which were made needle tips of darts, axes (Fig. 2). Axes were already composite tools (Fig. 3), which made it possible to accumulate a greater amount of mechanical energy by increasing the lift of tools and therefore making an impact so effective that the man was able to enter into combat with the major representatives of the animal world. In agriculture, composite tools (hoe, shovel) significantly increased the productivity of labor in the transition to it from simple sharpened sticks.

In the later period of the Stone Age (Neolithic), flint tools were replaced by the ones made of polished stone (Fig. 4), and in some cases faceted product forms are striking with their elegance and precision of finishing (Fig. 5).

On these early types of tools, there can be traced how their structural shape is determined by understanding of the causal nature dictating unity of

constructive form with the technological process of its use (Benjamin 48). The process of using a flint striker, like modern hammer, is the accumulation of energy in the raising tool due to the equivalent spending of energy by the worker. In the process of cutting by flint blade, like a modern knife, there is required concentration of enormous pressure on a small surface of the blade. At the heart of both processes, there are obviously laws of nature, studied by mechanics. Primitive man did not know the laws of mechanics as the current science. However, he found some patterns through experience, telling him that the hammer should be heavy, and a flint knife – sharp, that these design features best meet the requirements of the tools: crushed bone, cut a piece of meat (Liverani 50). Thus, the unity of a constructive form of tools with the process of their use, determined by the laws of the objective world, was learnt in work that accumulated material for subsequent generalizations, for disclosure behind the external manifestations of observed in the experience of their internal relationships, more general, deeper connection, for the establishment of science as a system of knowledge.

In the course of employment, there evolved first prerequisites for the subsequent emergence of the science of nature. Early complex instrument, which dramatically expanded people people’s possibility in the sphere of acquisition, was a bow and arrows (Backwell, d'Errico and Wadley 1567). Bow, bowstring and arrow already constitute a very complex weapon, invention of which involves long accumulated experience and sophisticated mental powers, therefore, simultaneous familiarity with many other inventions. These other inventions disclosed by archaeological survey was a complex of simple machines to carry out such processing methods like

polishing, sawing, drilling, and a combination of individual techniques. New technology has allowed to produce polished axes and hammers, arrowheads and spears, daggers and knives, fishing hooks, boomerangs, shuttles from a single tree trunk and paddles for them.

During manufacturing of complex tools man has mastered a new process - drilling, carried out by the use of rotary motion, which is unusual for human hands. This motion was made in the first drilling device representing already sufficiently complex structure, developing into the machine (Fig. 6).

In the above list of tools some titles are inherent to modern tools: axes, hammers, knives. This means that in many millennia BC there were found constructive forms and technological processes implemented with their help, preserved to our time. Indeed, modern hammer or ax differs from the primitive only by material, from which it is made. Stability of the hammer, ax and other tools invented in the ancient times, is not accidental. It stems from two reasons. The first is that in the ancient tools there were empirically discovered laws of nature, the use of which (such as the property of the wedge, cutting edge, etc.) is advisable in our time. The second reason is that these tools now, as in ancient times, are used as hand tools. So, their weight and size, determined by the capabilities of the human hand, are preserved as much as the hand kept its features.

Production of the slave period remained manual. Tools also were manual, as the size, weight, shape of hand tools were determined by worker hand, there have not been any significant changes in the elements of these tools. The main change was in the material of tools. The main material of tools and weapons becomes iron, and later - carbon steel. There was mastered

tempering steel, were sought methods of surface carburization of iron. Forced slave labor at the cost of thousands of lives of people killed in the mines from overwork and accidents, provided society with greater and greater amounts of metal (Sinclair and Sinclair 133).

In the period of the slave owning, hunting lost its former importance and despite the improved weapons, played only a secondary role. There was developed fishing, which was facilitated by developed method of construction of ships out of individual boards, improved fishing gear and nets.

Methods of impact on nature have developed significantly. There was increase in the range of cultivated plants. Apart from millet inherited from more ancient times, there have spread wheat, rice, barley, oilseed and fiber crops. The main instrument was the plow, first wooden, later with shingles, sheet-iron. As draft power for many centuries were used slaves. Application of domestic animals, especially oxen for plowing was quite rare: the use of cheap slave labor was economically advantageous.

Livestock developed by increasing the types of tame animals (Davidson and McGrew 798). There were raised pigs, sheep, goats, cows, who gave meat, wool and leather. Development of the production went both by increasing the number of artisans, and by allocating narrower specialties and professions. Blacksmiths and coppersmiths, potters and saddlers, gunsmiths and furniture manufacturers, and many other professions involved a significant number of workers, who specialized and improved tools and working methods of their craft (Fig. 7).

Surviving tools, their descriptions and images show that in the period of the

slave owning there arose and changed files, drills, cutters, scissors, lancets, saws, planes, braces, hammers and other hand tools (Edmonds 66). Due to this fact, there started to be used measuring instruments and tools: plumb lines, squares, compasses, rulers, which increased accuracy of processing. Development tools in the slave society proceeded in controversial circumstances. Slave, who was the main producer of wealth, was not interested in the performance of his work, did not try to improve the tools. Therefore, in the main source of wealth of society - agriculture and animal husbandry, - where slaves constituted the vast majority of the labor force, labor productivity was low, improvement of tools - small. In the field of industrial production, which served mainly to meet the demands of the slaveholding minority, where evolved the layer of free artisans, there was a process to deepen the division of labor, and with it the improvement of tools and processing methods. However, in this area a significant proportion of products was not consumer products: jewelry, ornaments, palaces and temples utensils, and so on. Significant development received the sophisticated tools that made up the machines of the slave period (Schick and Toth 277).

In the development of hand tools in the feudal period, significant progress was made. This progress was primarily due to the application of the material of higher quality and methods of its thermal treatment. There enlarged assortment of hand tools. There were developed sets of hand tools (instruments) in respect to a particular profession: carpentry, sewing, plumbing, and so on. There were developed greatly sophisticated tools, began the process of the emergence of new types of vehicles and the first

power machinery. Finally, in the systems of multiple mechanisms, there evolved conditions for the formation of technological machines, completely replacing the trained hands of the worker.

Transport vehicles in the feudal period have developed significantly. Cranes (Fig. 8) served a fairly wide area around the crane; rotation of the boom and movement of its truck allowed for serving any point in the volume of a cylinder, the dimensions of which are determined by the height and radius of lifting cargo and moving of truck. There were developed specialized construction cranes: for lifting loose elements, clearing the bottom of the harbor, and others.

Unlike the slave period when, as a universal energy " machine" was used only a slave, now there were increasingly beginning to use the energy of animals or inanimate nature for hoist applications. Where possible, for the movement of lifting device was attracted the energy of water flows.

There was significant development of water-lifting machines. For pumping water from deep mines and pits there were arranged pump units, consisting of a plurality of piston pumps arranged in series to avoid high pressure pipes made of wood. Such pump is driven by horses or water wheels (Hobsbawm 117). In addition to piston pumps there were used bucket elevators, scoop machines, in which the rise of the water was made by the moving riser chain of leather balls - pistons. The need to increase the number and height of the waters rise sharply raised the question of a powerful engine and subsequently served as the main base for the initial development of steam engines.

Development of technological machines went in several directions. The first

was aimed at enlarging machines with increased demand for their products. With the unification of artisans in cooperatives, with consolidation of craft production units, and especially with the development of the manufacturing production of various simple technological machines driven by disciple (pestles, grinders, graters, bellows and so on), they grew in size and required a more powerful engine. The development of production has led to an increase in the number of production machines. Increasing the size of the machinery and the number of its simultaneously acting elements required a larger motor mechanism, and the mechanism required a more powerful propulsion force (Nowotny, Scott and Gibbons 205). Thus, the first line of production machines - their enlargement - raised the issue of employing the energy of inorganic nature.

The second direction in the development of technological machines was in slowly releasing the employee from the technological functions of the production process. In the period under consideration this exemption has not yet attained the fullness when worker entirely transmits his technological functions to machine and begins the era of machine production, but the transfer of the functions is quite significant, as preparation for the machinery. This preparation in some cases reached up to the level of giving the machine the last, sometimes quite simple, operation of manual labor. For example, the predecessor of weaving was plaiting. Plaiting of baskets, mats, hats from the stems of plants of different species was first done without machines and tools, only by exceptionally skilled fingers worker. Then came the first tool, called elementary vertical loom, although it is substantially possible to see the same manual plaiting in it, only more organized by the

fixed position and the tension of warp threads. The separation of one group from the other of threads in plaiting, of the warp threads from the weft – that was the first step from plaiting to weaving. Then there was the next step in the technological process of weaving, in that even the warp angle varied periodically with respect to odd to warp, allowing the shuttle to move in a straight line. The development of the loom in the feudal period not only streamlined the movement of the warp threads, ensuring alignment and pressure outstretched wefts after each stroke of the shuttle, but also to convey the drive to legs of workers (Pobiner 118). Now the legs of a person performed a simple energy function of the engine, which is easy to replace with the work of the machine. Hands of a person driving a shuttle to carry out technological function, but so simplified, monotonous, uniform, that there was a possibility of transmission of the function to the machine as well.

This example shows how the process of technological machine, gradually simplifying operations of worker prepared the possibility of replacement with machine. A similar process can be traced in many machines, and for most of them bringing various technological characteristic movements to the simplest form: a line or circle.

The third direction of developing technological machines was to find new machines, new processes. There was mastered wire drawing on drawplates, rolling lead bars for window frames in rolling mills, drilling channels in trunks guns on drilling machines, straightening the sheets on rollers, tapping screws on lathes, and many other operations, for the implementation of which there were built newer machines.

Creation of a variety of machines prepared the ground for the subsequent transition to machine production, when technological machines would take over all the functions of the working process, leaving to people only the execution of control and logic functions.

Of great importance to the development of machines in the feudal period played grain mills. Requiring energy expenditure since its inception because of the high energy intensity of the grinding process, they gradually freed from muscular drive in slave society, where energy of the slave was the cheapest kind of drive. Starting from the IV century water, and from X century wind wheel was wider and wider applied to drive flour millstones. There were also developed systems for drive parts, shafts, wheels, gearing, bearings and other, bringing to life the complex mechanisms. However, it raised a number of problems of these mechanisms to mechanics and mathematics.

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