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MANIFESTATION OF THE LAWS OF EVOLUTION IN VARIOUS FIELD OF TECHNOLOGY

Yurii Kuznietsov*

Igor Sikorsky Kyiv Polytechnic Institute, Kyiv, Ukraine

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ABSTRACT

The main idea of the present plenary report is that the evolution of different technical systems obeys the same patterns of development over time. Appropriate examples are given to illustrate the main thesis and a discussion is made.

1. INTRODUCTION

According to the work of Balashov E.P. [1] all human activity is aimed at satisfying social and personal needs, which makes people interact with the surrounding Nature and enter into certain relationships with each other. In the process of such activity, Man creates continuously more complex and more efficient operating anthropogenic systems (AGS) - (from the Greek anthropos - a person, genesis - the origin, formation of a developing phenomenon) systems created as a result of consciously directed human activity.

We can conditionally single out the following stages in the development of tools created by Man: - the first tools of labor in the form of the simplest devices mainly from one part (sticks, stones, axes, knives, spears, etc.); - the simplest mechanisms (levers of the first and second kind, wedges, etc.); - complex mechanisms (gear drives, belt drives, screw mechanisms, etc.); - machines with manual and foot drive, using water, steam and wind, pumps, etc.); - machines with electric drive; - mechatronic systems, machines with artificial intelligence.

2. EXAMPLES AND DISCUSSION

In the history of the development of technology [2, 5, 6], with the advent of machines, they began to talk about industrial revolutions [19]. The first industrial revolution occurred with the advent of the steam engine in the second half of the 18th century, making the transition from manual to machine labor. The second industrial revolution is associated with the discovery and development of electricity and the emergence of assembly line production. The third industrial revolution began in the second half of the 20th century with the creation of electronic computers, and then digital computers - the basis of information technology (IT technologies). Today, humanity is facing the challenges of the fourth industrial revolution "Industry 4.0" with a wide penetration of automation, robotization, informatization, communication and everything related to society, business, production and education. The founder of the World Economic Forum, Klaus Schwab, noted that the time has come for the mass introduction of cyber-physical systems in production, blurring the lines between the physical, digital and biological spheres. Intelligent robots [22], drones, smart homes and cities, brain research have appeared, and the product in the process of release is able to determine the equipment capable of producing it [21, 23]. The fifth industrial evolution “Industry 5.0” is approaching, the impact of which on humanity is fundamentally new and not entirely predictable.

It is possible to explain everything that happens in the 21st century only using the laws of evolution of systems of various origins [1, 12, 13, 14], which will be further illustrated by examples in computer technology [3], electromechanics [13, 14], automotive industry [11], aircraft industry [20], robotics [22], solid-state mechanics [8, 15], in particular, machine tool building [9, 10, 19]. Academician Vernadsky V.I. and cybernetics, speaking about the biosphere and AGS [4], pointed out that they are formed by bone matter and are the habitat of living matter. AGS created by Man from bone substance, like biological objects, are in evolutionary development. It is proved [3] that the human brain has the same organization as an industrial enterprise.

In the general picture of the evolution of evolutions according to Zavadsky K.M. [6] artificial intelligence obeys the same laws of development as biological and ACS, passing through the following periods: pre-computer technology, pre-computer machines, computers with one instruction stream and multiple instruction streams (according to Flynn's systematics). It was possible to establish that the evolution of computing technology takes place under the influence of the natural law of homologous

* Corresponding author. E-mail: info@zmok.kiev.ua

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series according to Vavilov N.I., which is common for the evolution of the cell, Man and industrial equipment.

Electromechanics became one of the first technical disciplines where prof. Shinkarenko V.F. developed the foundations of the theory of genetic evolution of the structures of electromechanical systems [13, 14], in which he proposed the genetic classification of the primary sources of the electromagnetic field discovered by him (Generative system of electromagnetic elements). Historically, the founder depicted the origin of genetic electromechanics, starting from the technical electromechanics of the times of the second industrial revolution.

Evolution in the automotive industry can be illustrated by the examples of many well-known automotive companies producing cars and trucks, in terms of speed, weight, fuel use (energy sources), engine power, as well as design (appearance) (Fig. 1) [11].

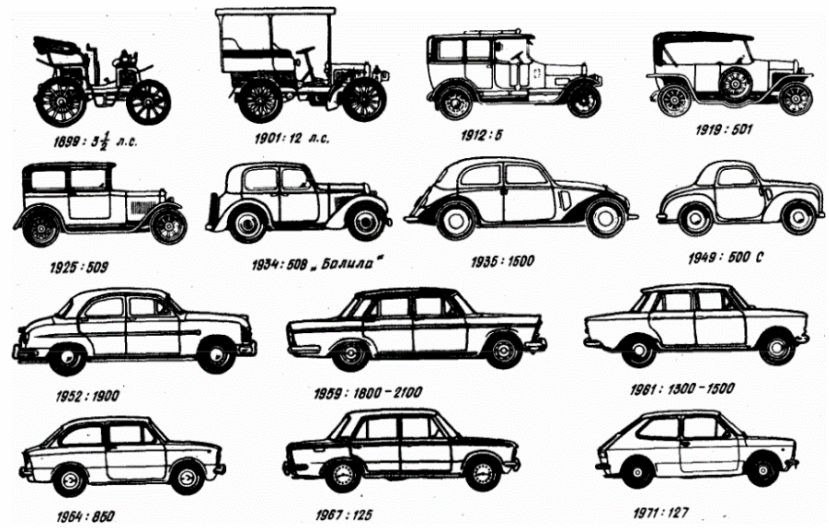

Fig. 1. The evolution of the shape of Fiat passenger cars [11]

Recognizing the laws of evolution as universal laws, American scientists presented their research and model of the evolution of civil aviation from the 1930s Douglas DC-3 transport aircraft to the giant Boeing 777 and 747 in the Journal of Applied Physics [22]. Like birds that can fly, the evolution of aircraft goes in the direction of increasing size while maintaining a certain ratio of engine mass to the mass of the entire body. In the animal world, this law also works: the mass of organs associated with movement (muscles, heart and lungs) must be proportional to body mass. American physicist Adrian Baidzhen, together with French scientists, analyzed databases of commercially successful models of civil aircraft in a number of ways. Two clear patterns have been established: 1) Over the century of the existence of aviation, aircraft are becoming larger and larger. 2) The ratio of hull mass to speed (Fig. 2) in most models ideally corresponds to a similar proportion in evolutionarily successful mammals, birds and insects. It is noted that the violation of these patterns in the Concorde aircraft led to their commercial failure.

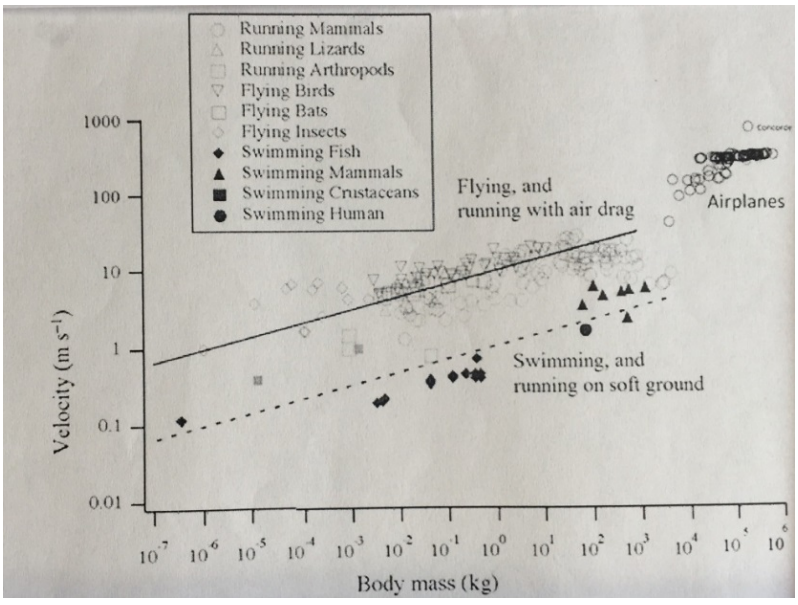

Fig. 2. The ratio of the mass of the body of aircraft to speed

In the article [24], scientists from the Institute of Robotics and Intelligent Systems of the Swiss Higher Technical School (Zurich) taught a "robot mother" to automatically assemble "robot children" from given components in order to track how they move, simulating the complex process of robot evolution without any

compromise. The main idea of evolutionary robotics is to build a population of simple robots, conduct tests on them, select several promising individuals and study their structure for reproduction in a new generation. The proposed system uses the basic laws of genetics, such as crossing over, mutation and interbreeding of elite individuals to create ten next generations from five experiments (Fig. 3a). 10 generations of robots were designed, evolved and improved (Fig. 3b). The conducted experiments show that the evolutionary process depends on the initial generation - the "mother-robot" (A) and increases its capabilities.

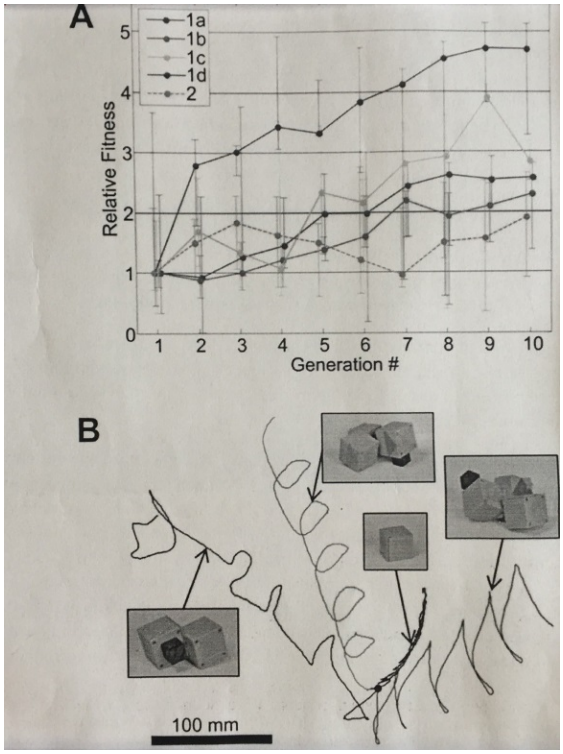

Fig. 3. The process of evolution of robotics in new generations of "children-robots" from "mom-robot" using a genetic approach

Not a single phenomenon of Nature, as the main creator, can be fully understood without applying the laws of mechanics, understanding their mechanical essence, and no new technique can be created without using certain objective laws in analysis and synthesis. Therefore, mechanics is one of the foundations of the progress of natural science and technology yesterday, today, tomorrow [2, 8, 25]. Logically speaking, it can be argued that it is advisable to unite all the sciences dealing with mechanics under the general name (concept) "genetic mechanics", where, depending on the environment, the informational language of description (modeling), the initial at the genetic level can be the smallest (simple) particle (gene in the form of an electron, electric charge, atom, molecule, bit, one wave, etc.), which in the general case for the transfer of information, abstract representation, synthesis, foresight can be combined under the generalized name "material point » [7, 9, 12]. Currently, there are concepts that reflect such diverse sciences as: solid body mechanics, hydromechanics, aeromechanics, structural mechanics, electromechanics, mechanics of a fluid (plastic) body, mechanics of a granular medium, thermomechanics, quantum mechanics, biomechanics, plasma mechanics, optical mechanics, celestial mechanics, acoustic mechanics, mechanics of chemical processes (combustion, synthesis of new chemical products), cryogenic mechanics, vibrational mechanics, etc. The above mechanical systems have their own evolutionary developmental features. However, from the point of view of the structural-systemic approach, everyone obeys the same principles [11]. This also applies to clamping mechanisms [7, 8, 12], for which, using a carrier of genetic information - an abstract material point, a generating system of clamping principles (end, radial, tangential) is proposed in the form of kinematic, force and energy flows from the energy source to the clamping object, the total number of which is 72 (and so far known and implemented within 30%).

Using the genetic-morphological approach, the concept of creating technological equipment of a new generation of frame layouts on a modular principle with computer control was proposed, successfully implemented for educational purposes in a small-sized version [8, 21]. Ahead of machine builders are waiting for new discoveries at the junction of various sciences, which once again confirms the relevance of an interdisciplinary approach. Fundamental work carried out at the departments of electromechanics (scientific supervisor prof. Shinkarenko V.F.) and machine design (scientific supervisor prof. Kuznetsov Yu.N.) in close cooperation, go in a common row with other studies devoted to the evolution of technical systems. It should be noted that if in the studies of previous authors it was only about individual analogies in the laws of evolution of nature and technology, then in the Igor Sikorsky Kyiv Polytechnic Institute. Igor Sikorsky for the first time proposed a systematic concept of the genetic evolution of natural and anthropogenic (including technical) systems, which logically explains the relationship of such fundamental concepts as: gene, genetic information, genetic code, chromosomes, generative elements, generative systems, genetic memory of a technical object, genetic programs, taxonomic categories (Species, Genus and Family), macro- and microevolutions, their relationship with the principles of symmetry and homology, P. Curie's pairing and desymmetrization principles, isotopy, isomerism, etc. [13-15],

which were completely absent in previous studies. Examples of the effectiveness of an interdisciplinary approach and a systematic concept of the genetic evolution of various systems are new generations of motor spindles, spindle assemblies, target mechanisms, mobile multi-purpose machines and robots, multi-spindle automatic lathes with electromagnetic fields without solid-state mechanical gears synthesized by Kiev Polytechnics, described in a single information language in the form of genetic codes and models [7, 8, 12, 15, 19, 20, 21].

3. CONCLUSION

It becomes obvious that Man is not the sole creator of technological progress, as previously thought, but remains only a student of Nature and one of her perfect creations. Everything that was invented by many generations of specialists, Nature has long provided for in its genetic programs. Nature establishes the laws of structural organization, creates genetic programs for the development of complex systems and dictates strict rules for their construction.

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