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**ANIMAL SCIENCE AS INTERNATIONAL INTEGRATIVE SYSTEM OF
SCIENTIFIC KNOWLEDGE**

The article highlights the main directions of formation and development of animal science, in particular breeding and selection, feeding, keeping and reproduction of farm animals. The priority researches of domestic scientists to develop effective methods of breed formation, line breeding, artificial insemination, sperm preservation, balanced feeding of farm animals and introduction of resource-saving technologies of their keeping were summarized. The author has proved that at different stages of development the domestic animal science accumulated advanced experience of foreign scientists to develop theories and methods of farm animal breeding, it used the best of breed in the world. At this stage the common efforts of foreign and domestic scientists is aimed at solving global problems - the conservation of biological diversity. This proves that the animal science is a international social phenomenon, its further development should be based on the creation of standardized assessment systems of animal pedigree value, creation of transboundary breeds, the development of ethical principles of animal cloning and others.

Keywords: *animal science, animal husbandry, breeding of farm animals, feeding, technology of keeping, reproduction of animals.*

The development of animal science is based on general foundations typical for all biological sciences as well as on specific knowledge. One of the basic of its development is its international character, proof of which is the historical formation and development of its main directions, teachings and theories, grounded by foreign and domestic scientists. Their integration facilitated to formation of a strong

foundation for further development of animal science and its transformation in the 20th century into a unified system of scientific knowledge, which has a crucial role in the qualitative transformation of large amounts of farm animals. At the present stage due to the necessity of solving the global problem of food security, the value of animal science increases.

The identification of animal science further development ways should be based on scientific study and creative use of enormous historical experience, which has been accumulated by several generations of scientists in the world on the issues of breeding, feeding and housing of farm animals. Therefore, the task of this study is the scientific and historical analysis of key trends, theories and doctrines of animal breeding, the grounding of its international character, as well as the identification of its future development directions. To do this the author has used common scientific, structural, functional, and special historical methods.

The simplest recommendations on farm animal breeding and raising have appeared yet in the era of primitive farming of the ancient peoples. Zootechnical generalizations concerning patterns of growth and development of animals, selection and evaluation by external forms, origin and quality of progeny are found in the scientists' and writers' works of the ancient world. During this period the doctrine of the breed and constitution of animals is emerging and the recommendations for feeding and raising youngsters are appearing.

The special studies on the cultivation of the horses due to their wide using were held in the Middle Ages. Standards and diets of animal feeding were developing with the transition from organic feudal farming to a commodity capitalistic one, when the farming started to be specialized in the production of certain products. The German scientists greatly contributed to the formation of farm animal feeding science. The theory of "hay equivalents", proposed in the first half of the 19th century by A. Teyer was the beginning of this zootechnical direction. U. Liebig, V. Henneberg, F. Stohmann, G. Groven, E. Wolf and others significantly contributed to the foundations of determining the nutritional value of feed, grounding of the feeding rules, development of feed rations [5].

Animal breeding art reaches a high level at the end of XVIII – early XIX centuries. Cultural breeds of sheep, beef cattle, pigs and horses have been created, the methods of breeding cattle have been improved. Regulated selection with different degrees of inbreeding becomes a new element of the breeding. The issues about the forms of selection and evaluation of animals on pedigree are raised. Public testing of animals is carried out, studbooks are open. Interest in the origin of breeds, methods of cultivation and refinement of the principles of animal selection for preserving the purity of the breed has appeared. A significant contribution to the development was made by the English animal breeder R. Bekvell, brothers Colling and others [1].

The scientific papers of French scientists J. Buffon, K. Burzhela, who developed the theory of crossing in animal breeding as well as teaching on the exterior, contributed to the development of zootechnical knowledge during this period. The theory of breed "constancy", grounded by Vekkerlin and Yustinus has been developed at that time. The zootechnical works of the classic German scientists H. Natuzius, H. Zettegast and others have appeared in the second half of the 19th century. In particular H. Natuzius firstly substantiated profitability of meat sheep breeding, formulated the concept of economic and biological maturity of animals. A tremendous impact on the development of animal breeding during this period had an evolutionary theory of Darwin, that became the foundation for further work on the creating of cultural animal breeds. The German scientists K. Damman, M. Klimmer laid the foundations for the development of the hygiene of farm animals [3].

The important works on the animal science of Russian scientists N. Chirvinskij, P. Kuleshov, M. Pridorogin, E. Bogdanov and others have appeared in this period. These works contained a lot of material on the origin, distribution, economic useful characteristics and measures to improve native breeds of farm animals, studies on the growth and development, the exterior and constitution, productivity, methods of breeding, normalized feeding of animals and others. In particular N. Chirvinskij developed scientific principles of farm animal feeding, which were based on a thorough knowledge of the laws of the physic-and-chemical mechanism of the digestion processes. Developments in the field of farm animal nursing and individual

development, steady-state study of sheep breeds, proposed by this scientist are of high priority in the world biological science [7].

In the development of animal science of this period K. Kronaher, Yu. Dyurst, J. Hammond, E. Dovenport, Ye.Liskun, N.Chirvinskij, P.Kuleshov, M. Ivanov and others made a significant contribution. In particular, J.Hammond proposed specific scientific papers on growth and development of farm animals, reproduction and lactation. E. Bogdanov, D. Kislovskiy created a scientifically based system of line breeding. The doctrine of the animal constitution received a new interpretation and development in the scientific works of E. Bogdanov, P. Kuleshov, Ye. Liskun, M. Ivanov. It was based on the concept of integrity of the animal organism and served as a theoretical basis for developing a system of scoring. E. Bogdanov, S. Bogolyubsky, V. Gromov, P. Kuleshov, Ye. Liskun, A. Browner made a significant contribution to the problem of the animal origin and domestication [8].

The methods of breed formation developed in the first half of the 20th century by academician M. Ivanov was the top of the farm animal breeding science. The fundamental strategic approach of the scientist to the local breeds was based on their further development on the base of optimization of feeding and management, complex reproductive crossing with more productive breeds of foreign selection. He also proved the efficiency of interspecific and intergeneric hybridization, acclimatization and domestication still undeveloped species of wild animals [4].

The development of a method of artificial insemination of animals by I. Ivanov was an important contribution to animal science that found on wide application in native and foreign practice of animal breeding. Method of long-term preservation of semen in the deep-state (at -196°C), developed by I. Smirnov, V. Milovanov, I. Sokolovskaya also became a significant achievement of the world animal science. This allowed to use in the selection process the most valuable bulls-producers and contributed to the further development of researches in animal reproduction sphere.

In the first half of the 20th century genetic methods have penetrated into the animal science. The use of genetics in the farm animal breeding contributed to a better understanding of the inheritance of individual traits. S. Wright, J. Lash,

W. Rice, F. Crew, K. Kronaher were the authors of valuable researches on the breeding of farm animals, which are based on the achievements of population genetics. Works on study of genetic processes in populations of farm animals were carried by S. Chetverikov, I. Schmalhausen, A. Serebrovsky, N. Dubinin and others.

A. Kellner carried a significant contribution to the development of the study of farm animal feeding. He grounded the scientific assessment of the nutritional value of feed on their productive action and suggested to use the starch equivalent as the unit of nutritional value of feed. G. Armsbi introduced terms as an energy unit to assess the nutritional value of feed. N. Fjord and N. Hanson developed the Scandinavian feed unit. In 1915 it was converted into a single Scandinavian feed unit which is still used in Sweden, Denmark, Norway, Iceland and Finland [5].

E. Bogdanov, M. D'yakov, I. Popov significantly contributed to the animal feeding. In particular E. Bogdanov worked out the Soviet fodder unit to assess the overall nutritional value of food. M. D'yakov and I. Popov proposed feeding rate for all types of farm animals and set up tables of food sustenance which has served long as the basis for the feed rations. Energy metabolic aspect has been studied and they established food caloric content that gave a possibility to set norms for the animal feeding.

In the early 20th century some vitamins and their role in animal nutrition has been studied. T. Osborne and L. Mendel discovered the rate of demand of laboratory animals in the essential amino acids, which provided the basis for the development of standards of farm animal needs in amino acids. With the improvement of techniques the studies on mineral nutrition have been significantly deepened and the theory of microelements was developed. It was clarified the indispensability of about 70 substances, elements, factors in the diet and their content in the feed.

At this period a lot of the fundamental issues of the theory of farm animal breeding have evolved, especially the doctrine of breed and the use of various forms of screening and selection, the problem of biological essence and use of inbreeding and heterosis in animal breeding, the doctrine of animal exterior and constitution, the problem of animal individual development. In particular G. Lash and L. Kryuger

substantiated the population concept of breed which gave an opportunity to reveal its essence through genetic notions. A. Samusenko, M. Zubets, V. Burkat proposed the system concept of breed which contributed to a more thorough study of its hierarchy, evolutionary interdependence of the components, openness and other characteristics. K. Webb substantiated the perspective of open population, the great advantage of which is the use of valuable specimens from any country, providing of permanent heterosis, acceleration of genetic progress [4].

Special attention was paid to studying of the problem of farm animal heterosis in the second half of the 20th century. Hypothesis, that have been substantiated by J. Haldane, B. Dodge, J. Rendel, B. Kirpichnikov, V. Strunnikov, V. Shahbazov, V. Konarev, G. Berdishev and other scientists have contributed to the investigation of its laws. Great importance was given to study of the problem of individual development of farm animals. R. Berg, S. Brodi, G. Shmidt, P. Pshenichny, A. Kvasnitsky, K. Svechin, V. Fyodorov, A. Kostin, F. Mescheryakov and other scientists have carried out a significant contribution to its development.

Methods of farm animal breeding have been greatly improved during this period at the base of fundamental study of the biological nature of pure breeding as the main method of breeding. There were developed the methodological grounds of line breeding and genealogical analysis. D. Kislovskiy, M. Kravchenko, F. Eisner and other scientists have made significant contributions to the development of these issues. The effectiveness of a wide use of different forms of crossing in animal breeding was justified. The evaluation systems of farm animals of all species on a complex of traits to determine their usage and breeding value were developed [1]. Development of animal science during this period was closely linked with the achievements of genetics owing to which there were carried out the study of blood, milk, chicken egg proteins to determine their variability, hereditary conditionality, establishment of connection with the animal vitality and productivity.

In animal breeding there were most widely applied the population genetics, which studies the changes of the genetic structure of large groups of individuals under the influence of external and internal factors. L. Hazel, J. Lash, J. Lerner,

R. Teynberg, D. Haldane, O. Harkavy, L. Ernst, V. Chemm, F. Eisner and others have carried out a significant contribution to the development of this direction. They grounded the efficiency of use of principles of population genetics during the construction of large-scale breeding programs and developed the fundamentals of selection indices composition [8].

The wide introduction of immunogenetics contributed to the development of animal breeding. The study of blood groups provided control over the reliability of animal origin. Genetic examination became the indispensable element of the selection process to improve existing and develop new breeds of farm animals. Immunogenetic data complemented the information on breeding and genetic characteristics of the lines. T. Andresen, R. Brown, B. Brenig, M. Foster, I. Rendel, C. Stormont, E. Tucker, Y. Suzuki, B. Rasmussen, A. Mashurov, L. Ernst, S. Ukhanov, V. Tikhonov, V. Gintovt, F. Eisner, E. Eydrighevich, V. Glazko and others have done considerable work in establishing of immunogenetic basis of selection [6].

The cytogenetic approaches in animal breeding were mainly used during the traditional cytogenetic monitoring as well as at the development of selection criteria for the selection and evaluation of breeding animals. Cytogenetic monitoring has helped to maintain the purity of populations and breeds at the base of identification and elimination of chromosomal abnormalities carriers. Developments that have been proposed H. Andersson, W. Anwar, P. Basrur, A. Bloom, B. Brandriff, Di Berardino, H. Dunn, F. Eldridge, I. Gustavsson, C. Hainan, H. Hanada, A. Herzog, W. King, B. Mayr, S. Long, Y. Miyake, C. Popescu, H. Swartz, N. Tomilin, S. Kulikova, T. Kiseleva, G. Isakova, N. Ilyinskikh, A. Zhigacheva, A. Graphodatsky, V. Kachur, A. Meleshko and others have contributed to the introduction of cytogenetic methods in animal breeding [8].

In the second half of the 20th century considerable attention was paid to the development of issues of farm animal feeding. Many livestock institutions were working on the problem of amino acid, vitamin and mineral nutrition of animals, studied their impact on animal productivity. Recipes of the protein substitutes, mixture of concentrates in particular mixed and pelleted feed have been developed.

Different recipes of mixed complete feed for various animal species have been proposed. The possibility of ensilage, yesting, malting, chemical preservation of fodder to improve their nutritional value has been proved. The zootechnical institutes have developed the principles for accelerated drying of fodder for preservation of vitamins. They substantiated the effectiveness of use of antibiotics, estrogens, tissue preparations, growth factors to stimulate animal growth. There were developed the bases of adult animals and sires feeding. K. Nering, E. Krempton, L. Harris, N. Denisov, N. Kleymenov, K. Solntsev, V. Fisinin, V. Guglya, V. Ryadchikov, N. Kurilov, V. Georgievsky, A. Modyanov, V. Bakanov, A. Venediktov, V. Scheglov, P. Viktorov, V. Kulikov, N. Gruzdev, A. Kalashnikov, A. Dmitrochenko, I. Danilenko, G. Bogdanov and others significantly contributed to the development of these issues [5].

The important researches on the animal management were held during this period. The most advanced methods of animal keeping, efficient modes of lighting and ventilation of livestock buildings, new ways of mechanization and automation of labor-intensive processes in connection with the creation of large livestock farms for breeding and fattening of animals have been developed. Optimal hygienic conditions for animal keeping in the various types of buildings for different climatic zones have been identified. Systems of work organization and methods of mechanization and automation of production processes in livestock breeding have been improved.

Considerable success in the field of animal breeding is achieved in the last decades. In particular, the biological phenomenon of breed is exposed from positions of the system approach. Theoretical conception of animal crosses heredity consolidation process at breeding «in itself» and reproductive crossing is worked out. Hypothesis of display of heterosis effect of animal crosses is offered and the reasons of heterosis fading in generations at further breeding are revealed. Effective methods for assessing of animal genotype and predicting of its productivity are found. The first phase of the study of biotechnology and genetics capabilities on the biological construction is completed. The beginning of the definition of animal true genetic status using the polymerase chain reaction is marked.

Developments that have devoted to the disclosure of the heterosis mechanism, its prognosis and management are of high priority. There are serious obstacles for the getting of the most effect out of heterosis hybrids for overcoming which animal science needs to solve a number of tasks. First, it is essential to develop technical ways of production of the F1 hybrids of some species of farm animals. Secondly, it is necessary to find out how to maintain the appropriate heterosis level in subsequent generations. Third, it is necessary to control the formation of forms with high combining ability.

Essence and genetic mechanism of individual farm animal ontogenesis is not yet fully explored till now. The solution of this problem would allow breeders to predict and manage the productivity of animals more accurately, to promote the qualitative improvement of breeding resources.

One of the most important problems of our day is the conservation of biological diversity which includes livestock as a significant part. Along with the continuous process of new breeds' development, some of them are endangered, because of intensive use of only the most productive of them. Native breeds have high adaptive and resistant qualities, strength of constitution, vitality, plasticity, unpretentious to the quality of feed and good feed efficiency, excellent reproductive qualities, multifetus pregnancy, etc. These breeds are a valuable cultural, intellectual and genetic heritage of all mankind. The problem of its conservation is particularly actual for the world scientific community [2].

Creation of transgenic organisms is one of the problems of today as well. It can lead to such negative consequences, as the rapid spread of new diseases, violation of the biological balance in the biological communities of plants and animals, mutations, developmental disorders and loss of offsprings. Particular attention should be given to the elaborations, which may result in entry of transgenic organisms into the environment, as well as the emergence of transgenic organisms which are resistant to all known antibiotics. Therefore necessary to investigate in detail the quality of the products derived from transgenic animals.

In recent decade valuable material in animal feeding on the study of biogeochemical zones for the deficiency or excess of macro- and microelements in the soil, feed, water has gained. A new direction is justified concerning a dietary feeding for the prevention of diseases and nutritional therapy for the treatment of sick animals.

In modern conditions special attention is paid to the development of such areas: 1) the development and introduction of a new generation of premises with high biological and beneficial action and antistress, immunostimulating abilities; 2) the development of zone recipes of open protein-vitamin-mineral supplements by using local plant protein feed; 3) the resolution of the amino acid nutrition normalization problem and other.

Efficient technologies, systems and methods of the keeping of various types of farm animals, their age groups and categories, which maximize the manifestation of their productivity were developed. Studies on the effect of light regime in farms, natural and artificial lighting on animal reproductive ability, productivity and resistance were held. The possibility of ultraviolet and infrared light use for animal keeping, air ionization in farms aiming to stimulate the young animal growth, increase productivity, prevent diseases and improve stall sanitary regime of animals was justified.

The effect on the animal productivity of such factors as natural and artificial radiation, noise, electric and magnetic fields, ozone is now studied. Zootechnical and veterinary-sanitary evaluation of the most common technologies in cattle, swine, poultry, sheep, horse breeding, fish farming and beekeeping has been held. Functional disorders of animals under the influence of physical inactivity as one of the negative effect of intensive technologies have been studied. Technological, transportation, climatic and other stresses that affect farm animals, have investigated and proposed methods of its prevention and control.

In modern conditions the special importance gains the problem of the development and implementation of resource preserving technologies in livestock production. They are based on the principle of selection, raw material, energy, labor,

organizational resource conservation. It gives the possibility to increase production and profitability of the livestock breeding.

Thus at all stages of forming and development of animal science it was characterized by an international character. Despite the national traditions and culture of livestock breeding in each country, animal science is based on a unified system of scientific knowledge. It is based on research activities, teachings and theories grounded by certain scientists of the world and recognized by the international scientific community. Their integration facilitate to formation of a strong foundation for further development of animal science, which has a crucial role in the qualitative transformation of large amounts of farm animals.

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