

## Prof. Michail Hristov (1895–1960) – founder of cytological, genetic and embryological studies in Bulgaria

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On 21<sup>st</sup> December 2005 were commemorated 110 years since the birth of the prominent Bulgarian scientist, Prof. Michail Hristov, the founder of cytological, genetic and embryological studies in Bulgaria. His legacy in these important biological fields of study is so profound and up-to-date that, although 45 years had passed since the end of his life, it is still difficult to speak of him in the past tense. His name is not only crowned with the glory of a pioneer teacher, but with his high scientific accomplishments, too, many of which have inspired admiration ever since and have made us feel proud. He is one of Bulgaria's scientists with a manifest national and international presence.

Prof. Michail Hristov was born in the town of Plovdiv to a teachers' family. Both on his fathers' and mothers' side he was descendant of heroic National Revival families. Prof. Hristov's grandfather was brother of the Bulgarian national hero, Kocho Chestimenski, in the 1876 April Uprising. His mother was sister of Petur Bonev, the leader Perushtitsa rebels. His familial memory emotionally charged with the glory of his ancestors, who gave their life for Bulgaria, influenced strongly his personality. He grew up as bright, patriotic young man, who loved deeply his motherland and was painfully sensitive to any injustice. He managed to retain these features throughout his life. All who had the honour of being his students or had worked with him knew his high moral principles, straightforwardness, unaffected manner and lack of selfishness,



Prof. M. Hristov  
(21.XII.1885 — 9.V.1960)

and his pure patriotism. His life philosophy, eloquently expressed in his behaviour, can be summarized in three words: motherland, family and work. For him, these were sacred words and he never made a compromise with them until the end of his life.

Prof. Hristov's childhood was marked by poverty. His father, a patriot and participant in the April uprising fell gravely ill and in order to make the ends meet with his meagre disability pension, the family moved into Perushtitsa, the native village of his mother. Young Michail received his basic education there and in 1914, after years of deprivation, finished high school in Plovdiv. Had we been able to turn back he clock of time to that period, we would have seen a thin and silent, simply dressed, not very tall youth, with a high forehead and large black eyes, looking with suppressed anguish. The times were harsh and the country was poor and in ruins. The Balkan war had just ended and the people suffered badly from the consequences and frustration brought about by the national catastrophe. The bright and studious youth wanted to continue his education. He was deeply convinced that by doing so, he would serve his motherland best. He wanted to study literature, but had no money. Young Michail Hristov was well aware that there were neither any available job opportunities for him to support himself, nor was his family able to provide such a support. However, destiny suddenly interfered with an announcement of the Ministry of Agriculture and

State Property for a Government scholarship competition for agricultural studies abroad. Being a dynamic and purposeful person, he did not hesitate. The country needed badly educated people to develop modern agriculture and young Michail Hristov was sufficiently motivated to make such a sensible compromise with his heartfelt desire. He won the competition and in 1915 went to Vienna as a student of agriculture. A fact from that period showed what a selfless and well-meaning person he was: two major personal qualities in his system of values. He used his small scholarship to support his brother's studies for a chemical engineer in Vienna. In 1921 Michail Hristov graduated as agronomic engineer.

Back in Bulgaria, the highly qualified agricultural specialist lovingly began work on updating the extremely primitive national agriculture ruined by the war. The well-informed agronomic engineer was well aware that, in the absence of industry, the only chance to revive quickly the economy of the country was to use the fine natural potential of Bulgarian agriculture. Thanks to his analytical mind, Michail Hristov understood that the process would require some wide-ranging educational, organizational and scientific efforts. Already then a major personal quality of his character came to the fore: the ability to think over, plan and organize in detail every problem he was dealing with. Wherefrom to start? He found the rational solution and focused his attention on lines and cultivars in which the country had greatest experience and traditions, namely tobacco and vegetable production. Two fortunate circumstances played a decisive role for his future development and for the fulfilment of set objectives: one was the opening of the Faculty of Agronomy at the University of Sofia, the second was a meeting with the eminent soil scientist, Academician Ivan Stranski, then Associate Professor and head of the newly opened Department of General agriculture at the new faculty. That experienced university professor and scholar was impressed by the expertise, ideas and emanation of the young specialist. He approved his intentions and advised the young man to concentrate on priority studies into the distribution and variety composition of Bulgarian tobaccos, owing to their economic importance. In the autumn of the same year he invited him to work as his Assistant Professor. The tobacco cultivars grown then in the country were genetically and morphologically heterogeneous populations, resulting from uncontrolled hybridization and

improved solely by the conservative method of continuous natural selection. After the first field visits, opinion polls and analyses, the young Assistant Professor drew some important conclusions: first, the tobaccos spread in Bulgaria were of the extensive type, well adapted to the soil and climatic conditions of the regions, but unable to achieve high yields or technical properties, and second, owing to their genetic heterogeneity, the Bulgarian tobaccos were invaluable as a genetic pool and stock material for effective genetic and selection work. These conclusions were to underlay a new, rationalised programme for more profound theoretical and experimental studies into the biological, physiological and reproductive tobacco characteristics with a set of modern cytological and genetic methods, which Michail Hristov implemented in the years to follow. Without these theoretical and experiential analyses it would have been impossible to carry out any exact taxonomic identification of the tobacco types and to improve their variety composition and economic properties.

The scientific and experimental work of Prof. Michail Hristov can be conditionally grouped and divided into three main periods. The first, from 1921 to the end of 1925, is a period of upgrading his scientific, methodological and educational expertise, a period of final decision-making for further scientific work. Supported and encouraged by the head of the Department, Ivan Stranski, and the prominent specialist in animal cytology and embryology, Prof. Todor Morov, in 1923-1924 Michail Hristov went to specialize in Germany, at the Institute for selection and genetics with the High school of agriculture in Berlin, and at the Institute of Agriculture in the town of Halle. For the purposeful young scientist that training opened up new vistas in the achievements of world botanical and agricultural science. He improved his German and practiced contemporary methods for the cytological, caryological, genetic and embryological analysis, as well as modern selection methods. Specialisation in Berlin and Halle increased his willingness to gain maximum experience and knowledge in microstructural botany, which attracted him very much, because Bulgaria lacked such specialists. On the following year he won a scholarship from the Rockefeller foundation and continued his education in one of the world's best scientific centres: the Institute of genetics and selection at Harvard University in Boston USA (1925-1927), under the supervision of Prof. E. East. Thus the

ambitious youth's dream to receive high education and to carry out scientific research in some fields extremely needed by his native country came true.

In the following decade he proceeded with his career in Bulgaria: Associated Professor (1926), full Professor (1930) and Head of the Department of Agricultural botany (from 1937 to 1960). He brought new methods, terminology and techniques for cytological, genetic and embryological analysis in Bulgaria and organized the first cytoembryological laboratory in the country. In spite of insufficient government funding, he turned the Department of Agricultural botany and the Faculty of Agronomy into a centre of cytological and embryological studies in line with the world leading standards for his time.

During that period he had relatively few publications, because his attention was focused on an inventory of the diversity of local tobacco species and his specialisation abroad. He embodied his awareness how important it was to have a better agricultural education in a dozen of popular-science articles targeting a broader audience and discussing organogenesis and modern technologies in agriculture applicable to staple crops: "Seed development in cereal plants", "What determines the production of brewery barley?", etc.

In 1923 Prof. Hristov published his first strictly scientific paper "Contribution to studying the locally grown cabbage species". It was based on material collected and analysed during his probation time at the Obratsov Chiflik farm in 1919. That paper also contained his idea of how important vegetable production was for the national economy. Its publication revealed the competence and erudition of the young specialist, but he did not go beyond the framework of technological, morphological and variety analysis of the studied cultivars. His interest remained focused mainly on the comprehensive studies into the problems of tobacco and tobacco growing. In 1923 he summarized the results of two years of research on tobacco into two scientific papers: "A scientific tour of the tobacco-growing centres in the Kingdom of Bulgaria" and "The tobacco varieties of *Perushtitsa*". Gifted with an ability to analyse, summarise and draw conclusions, the young scientist confirmed the opinion of T. Goodspeed & al. that, owing to genetic heterogeneity and strongly-expressed polymorphism, it was impossible to identify the interrelations and systematic units in genus *Nicotiana* only on the basis of morphological analy-

sis and method of inquiry. Along with this, the species and cultivars of genus *Nicotiana* were perfect model objects for cytogenetic experiments and analysis. That first stage of inventory-making and study of Bulgarian tobacco varieties and species set up the background for further in-depth studies by application of an array of modern analytical methods: caryological and genetic analysis, emasculation and isolation experiments, meiotic analysis and progeny tests. In the following years, and especially after his two specialisations abroad, Michail Hristov successfully implemented that task and laid down the foundations of cytological, genetic and embryological studies in Bulgaria.

The second period of the scientific and research activity of Prof. Hristov was closely linked with his specialisation in Germany and the USA. Already armed with profound theoretical and methodological knowledge in plant reproduction, genetics and selection, cytology and embryology, with fluent German and English, in 1925 he published two papers which attracted the attention of tobacco specialists: "Cytological studies on genus *Nicotiana*" and "Inheritance-experimental studies of some tobacco varieties". These publications marked the beginning of some more detailed studies into the cytogenesis and modern genetic selection work on tobacco in the country. They were followed by a string of eight detailed papers, highlighting all aspects of cytology, caryology, meiosis, hybridisation potential, and sterility in the species of genus *Nicotiana*. It is impossible to analyse here all scientific contributions and work of Prof. Hristov in this field, but here are some articles, to name a few more significant: "Cytological studies in the genus *Nicotiana*" (1928), "Cytological studies on some species hybrids of *Nicotiana*" (1929), the overview "Changes in organisms in the light of chromosome theory" (1929), "Genetic survey of *Nicotiana tabacum*" (1935) co-authored with G. Gentchev, etc. In these articles focused on this field and expressing his profound interest in the species of genus *Nicotiana*, Prof. Hristov drew some important conclusions and registered new findings highly valued by the world's leading scientists, namely, Prof. E. East, G. Stebbins, A. Gustafsson, A. Müntzing, M. Skalinska, etc. His high-priority findings included the identification of new and confirmation or correction of the already reported chromosome numbers in many species of genus *Nicotiana*; identification of four new types of meiosis in the interspecies hybrids of the same genus;

validation that it was possible to use the meiosis types for elucidation of genetic similarity, incompatibility and taxonomic status of arguable taxa of the genus; and recorded subordination between the chromosome number and relationships of hybridization among the genus species. He demonstrated experimentally that in reciprocal crossing hybridization is more successful, if the mother organism has a bigger chromosome number. This dependence was lately accepted as universal. The above-listed contributions brought huge international prestige both to Prof. Hristov and to the young Bulgarian science. In this connection, another element in his biography merits attention. Following his first publications in English on the cytology of tobacco, and especially after his paper on polyploidy and apomixis in genus *Potentilla* delivered at the 7<sup>th</sup> World Congress of Genetics, he was invited by Prof. East of Harvard University, who was strongly impressed by him, to become his assistant, but Prof. Hristov refused. Bulgaria needed his knowledge and nothing, not even the attractive invitation to work in one of the world's biggest scientific centres under incomparable conditions, could tempt him make a moral compromise with his beliefs.

The scientific interests of Prof. M. Hristov were not limited only to the caryology of species from genus *Nicotiana*. Alone, or jointly with the first young scientists trained by him – A. Popov, G. Gentchev, G. Papazova – he carried out cytological and caryological studies of the species from families *Vitaceae* (*Ampelopsis*, *Vitis*), *Solanaceae* (*Petunia*), *Rosaceae* (*Potentilla*), *Asteraceae* (*Hieracium*). That period brought to the fore another aspect of his character: benevolence to young scientists and ability for team work.

In spite of the markedly fundamental and theoretical line of his scientific interests, Prof. Hristov worked successfully and efficiently in the field of tobacco selection. His excellent knowledge of the climatic and soil conditions in the tobacco-growing regions, of the biodiversity of local populations and of the contemporary selection methods helped him create several original, highly-productive tobacco varieties, well adapted to market demands, tobacco handling and tobacco processing industry. Two of them, “*Ustinski 1*” and “*Ustinski 4*”, were internationally acknowledged and grown in other countries. They were practical expression of Prof. M. Hristov's competence as an agronomical botanist, geneticist and selector.

After 1935, Prof. M. Hristov shifted his interests for good onto the issues of reproductive biology of plants: mainly on the apomixis. A lively dispute was then under way in the embryological circles about the reasons for appearance, peculiarities and evolutionary importance of this unique way of embryo- and seed-formation without fertilization. Emphasis was increasingly laid on the practical importance of this process for the selection and seed production, because of the possibility it offered for obtaining homozygous plants, the fast transfer and establishment of valuable economic characteristics and the heterozygous effect in the progeny. Alone, or in coauthorship with A. Popov, G. Papazova and M. A. Hristov, Prof. M. Hristov published 11 papers in this field, which had found their place in the history of apomixis studies and have been widely cited ever since. Due to the limited numbers of trained personnel, the apomixis studies were not comprehensive and were limited to families, genera and species with the highest accumulation of apomicts: *Rosaceae* (*Potentilla*) and *Asteraceae* (*Hieracium*). Faithful to his style, Prof. Hristov first established a collection of apomictic forms of selected model species from the two genera (*H. racemosum*, *H. gothicum*, *H. bupleuroides*, etc.). His first paper in this field “*On the reasons for virgin reproduction of plants*” (1936) was an overview. In this paper, and in another overview, “*Apomictic reproduction in the world of plants*” (1942), he criticised in brief the developed classification of apomixis and the discussion of the reasons for its evolution. In the years to follow, with a small team of associates trained in embryological analysis, he published the results of the studies on cytoembryological characteristics and apomictic types in the species of the two above-mentioned genera. Their most important contributions included the papers: “*Polyploidy and apomictic development in genus Potentilla*” (1939) in English, “*Apomictic reproduction in the plants world*” (1943) in German, “*Genetic studies of Hieracium aurantiacum*” (1942) in German, etc. These publications in some of the most prestigious international journals, such as *Genetics and Planta*, in English, German and French, attracted the attention of the international scientific community with their insight and were widely cited by the world leading scientists in the field of cytology, caryology and apomixis, namely: A. Gustafsson, G. Stebbins, A. Müntzing, and M. Skalinska. Thus, the Bulgarian cytoembryological school established by Prof. Hristov received high international recognition and in the

1930s was considered a leading school in the apomixis studies, along with the Swedish and German schools.

Prof. Hristov had contributed strongly to the field of plant embryology and his contributions were recognised worldwide. Some of these major contributions included the discovery of the genetic basis for apomixis types in the studied species of the genera *Potentilla* and *Hieracium*; identification of the relationship between proven apomicts and their amphimict ancestors; and determination of the proportion between the two modes of reproduction in the studied species and populations. His analyses and papers are still model examples of the general principles and precision study of the apomixis. One of his most important contributions to apomixis studies was the provision of persuasive theoretical and experimental evidence that the hypothesis of hybridization of Ernst (1918) and the theory of polyploidy of Thomas (1940) were unfounded and that apomixis was genetically determined, but its occurrence was conducive to polyploidy, hybridization and sterility. Already before the genetic hypothesis of Powers (1945), now widely accepted in embryology, Prof. M. Hristov had come to his own conclusion.

An indication of the contribution and international prestige of Prof. Hristov in the field of tobacco cytogenetics and plant embryology was the invitation extended to him to participate in the 7<sup>th</sup> World congress of genetics (1939) and his election as Member of the Genetics society of America (1937) and the International scientific society on tobacco (1939), where only renowned world scientist were holding membership.

Prof. M. Hristov was not only an internationally acknowledged scientist in the field of cytogenetics and plant embryology. He was also a prominent university professor, one of the pioneers in the field of contemporary higher agronomic education in Bulgaria. It was a happy circumstance that he was promoted as Head of the Department of Agricultural botany in 1937, which had been under his guidance in the course of 23 years, until the end of his life. He maintained that botany was a key discipline, the alphabet of agronomical science and practice, and that without profound knowledge of the cell structure, tissues, organs, reproductive cells, and biodiversity in plants and fungi, the future agronomists would not only encounter difficulties in studying the other biological and plant-grow-

ing subjects, but would also fail to effectively apply the modern agrarian technologies. He saw the agronomic practice as the broadest possible field of applied botany.

Prof. M. Hristov read the first lectures in genetics in Bulgaria to the students in agriculture and forestry. Since 1937 he had read the general course of agricultural botany, which included extensive sections of cytology, anatomy, plant morphology, mycology, and botanical taxonomy. As a knowledgeable and highly qualified scientist, he transferred the European standards into his teaching work: organized a training herbarium and slide collection, established a training collection of live plants, supported the plant propagation departments in the establishment of test plots, nurseries and varieties. Along with his, Prof. Hristov wrote the first textbook on genetics in Bulgaria (1946), as well as the first textbook on agricultural botany (1946). The concept and layout of these textbooks have been inspiring admiration ever since not only with their detailed presentation and comprehensive information, but also with the way they were adapted to the specific requirements of various agricultural lines and the balance between the different parts. In the period 1936-1951, he wrote five textbooks, each specifically adapted to the requirements of the relevant educational profile: *Genetics* (1936), *Agricultural botany* (1946, 1947), *Applied Botany* (1947), and *Botany for Foresters* (1951).

Prof. Michail Hristov, the founder of the cytological, genetic and embryological studies in Bulgaria, initiator of the internationally recognised Bulgarian cytoembryological school, did not receive in his lifetime the deservedly high appraisal of a scientist of international renown and prestige. The period of his work as mature scientist and teacher coincided with the time of strong political tingeing of science. The fact that he had specialized in Germany and USA and that his scientific philosophy and studies ran contrary to the "great theory of Lisenko" doomed him to unwarranted distress. However, his scientific work is highly valued and recognized in Bulgaria now.

In the history of Bulgarian science– and the history of science in general is part of the history of every nation– the name of Prof. Michail Hristov marks one of the highest peaks reached in the field of cytogenetics and plant embryology.

