

Historical Development of Nematology in Russia¹

S. G. MJUGE²

Abstract: The development of Russian nematology is considered from the late nineteenth century to 1970. The dominant influences of I. N. Filipjev and A. A. Paramonov are discussed in the context of the persons whom they influenced and their conceptual approach to the problems posed by nematodes. The advantages and disadvantages of the framework of Russian scientific administration are compared to those in the West. **Key Words:** Filipjev, *Heterodera* spp., *Meloidogyne* spp., Paramonov.

Science develops through the gradual accumulation of information and often changes direction with the development of new ideas, or new approaches to old concepts. In Russian nematology, conceptual landmarks and scientific leadership were provided by I. N. Filipjev and A. A. Paramonov. The development of nematology in Russia is discussed with respect to the contributions of these great men.

Period before Filipjev: Russian nematology has always lagged behind that in the West; it began later and in many technical aspects is still behind. The earliest published descriptions of nematodes go back only to the last decades of the last century. The nematodes that were first described were those visible to the naked eye or those which caused striking pathological changes in plants. For instance, in examining grape vine roots for the presence of *Phylloxera*, the Crimean *Phylloxera* Committee (10) found root-knot nematodes. Similarly, in different areas, *Heterodera* was found on beets by Tolpyguin (28), by Veinberg (30) in the Ukraine, and by Tarniani (27) in Georgia.

This was an age of the collection and description of nature and it lacked a unifying conceptual framework. There were occasional zoological studies, such as that of Golovin (8) who examined the excretory system, and articles began to appear in some

popular agricultural journals such as *Khozyain (The Landlord)*. Sometimes these consisted of complete translations of foreign articles, such as one by J. Kuhn (11).

Also during this period, a considerable amount of descriptive material was published outside of Russia. Bastian (1) tried to summarize this information in a monograph, an objective furthered by De Man (12). However, little synthesis or analysis was attempted in these monographs. After Charles Darwin's ideas began to gain acceptance in biology on the eve of the 20th Century, scientific thought required more than descriptions.

I. N. Filipjev period: The first part of Filipjev's work was published in 1918, and this was followed in 1921 by a second major contribution under the modest title of *Free-living Marine Nematodes in the Vicinity of Sebastopol* (4). In this paper, the author described 100 new species. If he had limited himself, as was usual at that time, to their description, or had even tried to classify and group them upon some morphological criteria, it is doubtful that his work would have met with the enormous success that it did. Filipjev took a great conceptual step by causally relating form and function. In order to analyze the marine nematodes that he had collected, he drew upon the available literature on free-living, soil, microbivorous, and plant-parasitic nematodes.

He approached morphology on the basis of the total organism and not, as previous publications had done, on the basis of separate organs. Thus he created the first logical and comprehensive system of nema-

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²Institute of Parasitology, Macdonald College of McGill University, Macdonald College, Province of Quebec, H0A 1C0, Canada. I am grateful to Dr. Katherine Berdnikoff for essential help in translation and to Dr. Neil A. Croll, Director of the Institute of Parasitology, for providing me with laboratory facilities, encouragement, and help with this manuscript.

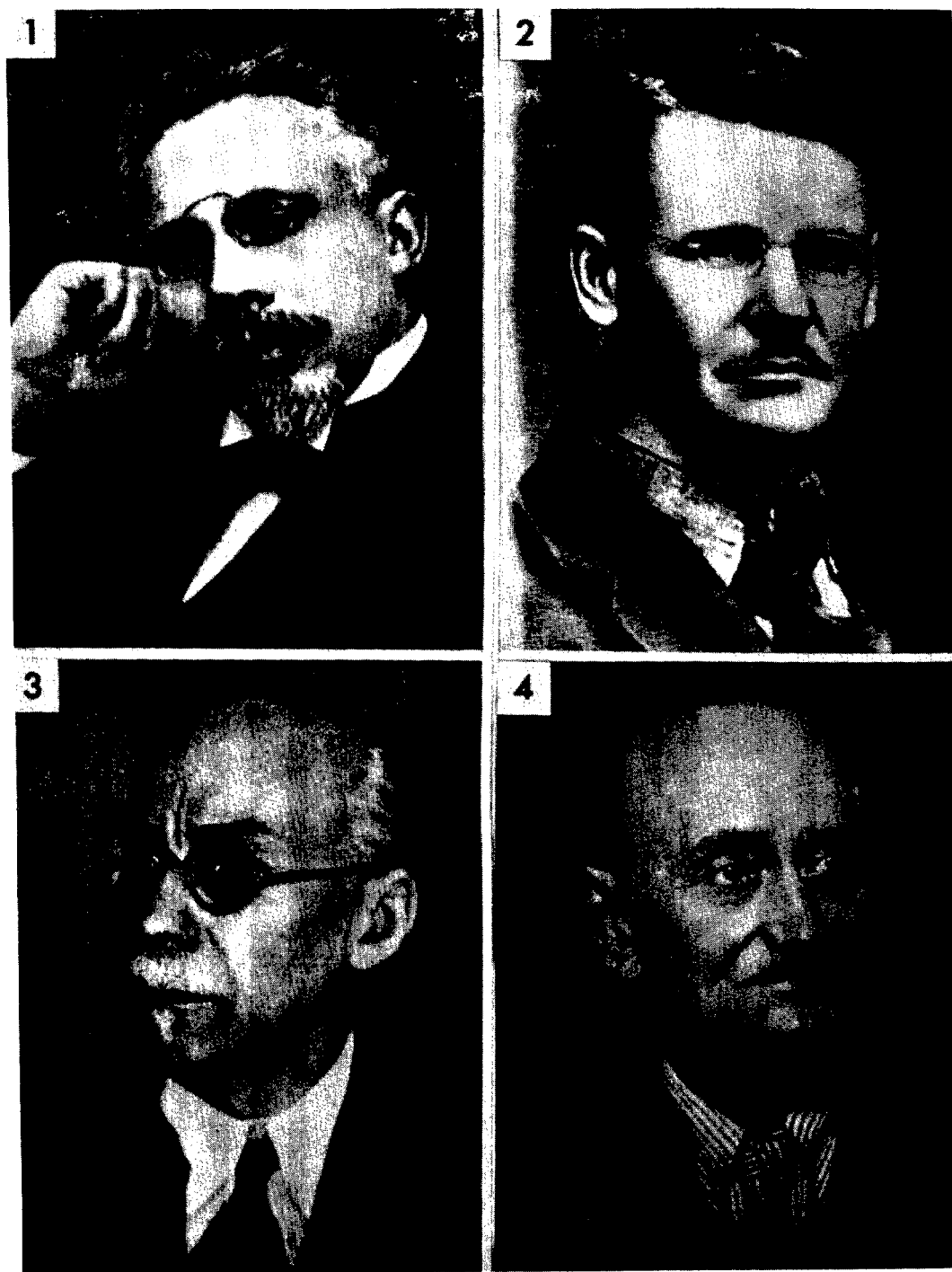


FIG. 1-4. Early Russian biologists. 1) Aleksei Nikolaevich Severtzev (1886-1936). 2) Ivan Nikolaevich Filipjev (1889-1940). 3) Ivan Ivanovich Schmalhausen (1884-1963). 4) Aleksander Aleksandrovich Paramonov (1891-1970).



FIG. 5. Group of Nematologists at the USSR Academy of Science. Back row (left to right): K. I. Schpakovskay, A. A. Paramonov, E. S. Turlygina, T. V. Pioroyskay; Front row (left to right): T. A. Gluzhenko, N. I. Sumenkova, S. L. Lazarevskaya-Blinova, P. S. Krulov, S. G. Mjuge.

todes which was based on scientific data. The translation of his work into foreign languages drew considerable international attention (21). The previous unnatural systems of Cobb (3) and Micoletzky (13) were overtaken. Micoletzky (14) renounced his system of nematode classification and accepted that proposed by Filipjev.

In 1934, Filipjev enlarged and deepened his ideas (5), and in the same year published a monumental volume—*Nematodes that are Harmful and Useful in Agriculture* (6). This publication became a basic text for Russian nematology and was widely read in other countries. In 1941, this work was reprinted in an enlarged edition with I. H. Schuurmans-Stekhoven (7), but Filipjev himself did not participate in the final production. In the West, Filipjev was “reported as missing,” while his Soviet colleagues were told that he was

“an enemy of the people.” His published works were removed from many libraries and destroyed. According to official sources, I. N. Filipjev died in a concentration camp in 1941; according to Kirjianova (9), he died on October 22, 1940. Filipjev was posthumously “rehabilitated” during the Khrushchev regime.

The period between Filipjev and Paramonov: New ideas arose in Russian biology in the “post-Filipjev” era. A. N. Severtzev (24) found new methods of relating form and function to habitat. Today, he would be called an ecologist. Proceeding from the ideas of Darwin, he laid a new foundation for evolutionary morphology which was a definite advancement over the descriptive morphological approach of Karl Gegenbaur (1826-1903) and the comparative morphology of Ernst Haeckel. Important conceptual advances

were proposed by I. I. Schmalhausen (25) who analyzed the mechanisms of evolution. The theories of "prototypes" and "architectonics" were developed in 1944 by V. N. Beklemishev (2) who foresaw numerical taxonomy and phylogeny within the higher taxa.

By 1936, nematology had been influenced by the conceptual advances of evolutionary theory and by related developments in general biology. A new applied science of helminthology had been defined as "the study of worms and the diseases that they cause" (26) with its subdivision "phytohelminthology" which concerned plant-parasitic nematodes and diseases caused by them.

Following the demise of Filipjev in Russian nematology, a large collection of nematode specimens remained in the Zoological Institute of the Academy of Sciences of the USSR. This collection was preserved and enlarged by Filipjev's assistant, E. S. Kirjanova (9). She picked up the baton from Filipjev and enriched Russian nematology through her varied research contributions and through training of additional nematologists. Among her students are E. L. Krall, T. S. Ivanova, A. T. Tulaganov, and many others; these are the "grandchildren" of Filipjev.

Professor Tulaganov held the posts of Professor of Invertebrates in the Department of Zoology at the University of Tashkent; Rector of the University of Samarkand; and Director, Institute of Parasitology, Uzbek, S.S.R. He trained many nematologists who worked on applied problems but published little. Possibly even great-great grandchildren of Filipjev can be derived from this tree of nematological development. The main direction of the Tulaganov school is systematics and faunistic studies.

Soviet nematology has not been derived entirely from Filipjev and his school. In the Ukraine, in the early 1920s, I. I. Korab began working in the Agricultural Institute of Bielaya Tserkov (White Church). He was concerned with *Heterodera schachtii* since this was the center of the sugar beet industry in Russia. As a novice nematologist, I made a pilgrimage to see him. As the oldest of our Soviet colleagues, he astonished me with his youthfulness. At 70

years of age, he skied actively, rubbed himself with snow, and swam in ice holes! He knew all that was then known about *H. schachtii*. He trained a few specialists in pest control but left no "heir" to his area of nematology, with the possible exception of B. I. Kulchitsky. Apparently, one nematode species alone was too little to occupy two generations of nematologists.

Another "species" of nematode, the root-knot group, became the main object of study in the entire life of A. A. Ustinov of the University of Kharkov. I say "species," since Ustinov insisted to his dying day that there was only one species of root-knot nematode: *Meloidogyne marioni* (Cornu). In contrast to I. I. Korab, however, Ustinov had much wider interests than just the systematics of root-knot nematodes. He also studied physiology and ecology. As a result of his leadership, there remained after Ustinov's death a strong and versatile group of plant nematologists: N. M. Ladygina (ecologist), V. G. Zinoviev (biochemist-physiologist), and Z. G. Volodchenko (morphologist).

In the 1930s, there was a drive to develop the rubber-bearing plant, *Scorzonea tau-saghyz*, because natural rubber was not available in Russia and the technology to synthesize rubber was not then known. The growth of *S. tau-saghyz* tubers was often hampered by disease and nematodes. As a result, the first specialized laboratory in phytonematology was opened in Moscow in 1933 under the Directorship of N. M. Sveshnikova. Sveshnikova soon became the leading authority on the chemical control of soil nematodes in the Soviet Union. She trained L. A. Guskova, widely known in U.S.A., who is now Head of the Department of Phytohelminthology of the All Union Institute for the Protection of Plants in Leningrad. T. S. Skarbilovitch succeeded Sveshnikova in the *tau-saghyz* laboratory and later devoted much time to the study of the biology of *Heterodera*, especially *H. schachtii*.

In the early 1920s, the zoologist N. M. Kulagin developed an interest in nematodes. It was a small part of his professional career and he produced only two articles in 1927 and 1928. His real contribution was to acquaint one of his students, A. A.

Paramonov, with nematodes and nematology.

A. A. Paramonov: Paramonov became Professor of Darwinism in 1937 and Professor of Zoology in 1941 at the Agricultural Academy of K. I. Timiriazeff in Moscow. He held both these appointments until 1948. Paramonov received a sound basic background in biology under Professor O. Butschli at the University of Heidelberg. He was also influenced by the leading professors of that period in Moscow and St. Petersburg. Paramonov was first a theoretician, but because of his vocation and position within an agricultural academy, he made contributions to applied agriculture.

Although Paramonov began to be interested in nematodes in 1925, his main interests until 1948 had been in general biology. He was the author or co-author of almost all of the more popular textbooks and books published in the U.S.S.R. on the subjects of Darwinism and zoology. These included encyclopedias and the Soviet edition of Bremm's *Life of the Animals*. Because of the politicizing of Soviet biology in 1948, Paramonov was forced to abandon the university chairs that he occupied and he turned exclusively to helminthology. Paramonov applied for his retirement pension in 1970 but did not expect to have his application accepted. He wept when, as an economy measure, his retirement was agreed upon, and he died one month later. From 1952 until his death in 1970, he was Head of the Section of Phytohelminthology of the Helminthological Laboratory of the Academy of Sciences of the USSR. Paramonov viewed phytohelminthology as a complex discipline in which the comprehensive study of nematodes must merge harmoniously with questions of plant pathology. He soon assembled a group of phytohelminthologists interested in all aspects of nematology.

The first ecological classification of nematodes was published by Paramonov (17) in 1952. In it he analyzed the relationships that existed between plants and animals. This system was an outgrowth of the system of Filipjev and, as an existing natural system, it has stood the test of time. In 1962, Paramonov (21) enlarged the system further. As a peripheral aspect

of this work, he conducted research into the specificity of plant parasites with respect to agricultural practice in Russia (18). On the basis of earlier studies by Severtzev, Schmalhausen, and Beklemishev, he produced a cohesive theory of the phylogeny of nematodes (19, 20). The breadth of his vision led to the idea that nematodes were to be considered as components in the natural "ecosystem" and that their presence was to be viewed as a consequence of the environmental conditions. This view enabled correlations to be drawn between nematode populations and the habitats of their plant hosts. At its best, this approach could be used to predict outbreaks of disease which related to agricultural practices and climatic conditions. Together with his co-workers, Paramonov moved towards a centralized theory for the "therapy of phytohelminthoses."

He presented his theoretical principles in a three-volume work: *The Basic Principles of Phytohelminthology* (21, 22, 23). All of these volumes were translated into English. Unfortunately, Paramonov did not complete the last of his planned volumes in which he intended to describe the theory of controlling "phytohelminthoses." He died on June 11, 1970, and left the most radiant memory in all who were privileged to know him.

Despite his important position and the fact that he was a man of great principle, he was a remarkably kind, gentle, and sympathetic colleague. He lived in a communal apartment and occupied one room which was divided into three "cubby-holes" by plywood walls. In addition to normal inhabitants, there were always some wounded pigeons, stray kittens, or puppies. One could always come to him with any—even the most trivial—questions, or without any question at all. Any time of the day or night, one could count on a warm welcome and we, his students, all too often took advantage of this.

The study of nematodes in Russia: The works of Filipjev and Paramonov have left a lasting impression on Russian nematology. The first instructions for collecting nematodes and examining diseased plants were those of Filipjev (1932). Filipjev (4) became so convinced of the ubiquity and ecological specialization of nematodes that, describing

nematodes of the Petrograd area in 1921, he described species which, in his opinion, should have existed there. The species were, as it happens, discovered there at a later date!

Since every faunist strives to discover new species, most Russian researchers did the same and concentrated on the "exotic areas" such as Armenia, Azerbaijan, White Russia, and Central Asia. Meanwhile, nematodes in the central part of Russia remained completely unknown (20).

In contrast, Paramonov felt that the study of phytohelminthoses should be comprehensive. He wished to proceed by developing a total description of the fauna, not only by a one-time, widespread sampling but by regular sampling of the same habitat. Then, the various factors promoting the increase or decrease of pathogenic species should be elucidated; and ecologists should study the inter-relationships of nematodes amongst each other and with fungi, insects, bacteria, and other organisms. Therapy, Paramonov believed, should follow the studies of physiologists and biochemists who would establish the factors that could decrease populations. This approach was the essence of applied Russian nematology.

The development of therapy for phytohelminthoses: Paramonov organized a group of physiologists whose role it was to find "nematostatic" substances (E. S. Turlygina) and to study the physiology of nematode nutrition (S. G. Mjuge). Turlygina (29) showed *in vitro* that the sexual reproduction of *Rhabditis* spp. was inhibited by potassium rhodanite, ammonium nitrate, and sodium salicylic acid. The same substances inhibit the laying of eggs by *Meloidogyne incognita* if plant hosts are treated.

S. G. Mjuge determined that some plant nematodes possess extra-corporeal enzymes for digestion of host tissues. These secretions were considered a target for destroying nematodes. In order to provide a firm basis for understanding extra-corporeal secretions, and in the traditions of Filipjev and Paramonov, it was decided to examine the evolutionary pattern of secretory function (15). Mjuge demonstrated that the catalytic enzymes for carbohydrates varied among species, but that a cathepsin-type of

proteolytic enzymes was found in all the species investigated. The activity of this latter enzyme was linked to the presence of specific hydrogen donors that activated it and played an important role in the respiration of the host. By influencing the respiratory metabolism of hosts, it became possible to inhibit the proteolytic activity of the nematodes. This reaction reduced their nutrition and their sexual reproduction (16).

The goal orientation of the research done by all members of Paramonov's group gradually became side-tracked into individual projects. Up to a point, the qualities of Paramonov played a negative role, for he understood the individual creative aspirations of the members of his group and permitted them to develop. The real disintegration of the central theme came about by the destructive nature of Soviet science.

Contemporary factors in Russian nematology: It may be seen that Russian nematology is more classical and conceptual, even in its approach to control, than the more pragmatic approach of Western science or nematology. Recent developments have not favored entrepreneurial approaches. This situation is related both to the security and confidentiality of some government laboratories and to the participation of the USSR in the International Patent System.

The Academy of Science is officially totally independent in its scientific affairs. It is there that theoretical problems are tackled and the results are ultimately transmitted to the appropriate government ministries. From a practical point of view, control of science in USSR is in the hands of the Central Committee of the Communist Party of the Soviet Union. Within the committee, there is a "Department of Science" which directs scientific affairs, including applied problems. For instance in 1965, the Central Committee was persuaded that the spread of cotton wilt was caused by nematodes. As a result, the Academy of Sciences received the suggestion that all helminthologists should become involved in the solution of this problem. I. I. Skrijabin had to display enormous political talents to avoid total commitment of himself and other members of his group

to this assignment. It later transpired that nematodes did not play an important role in the spread of *Fusarium* and *Verticillium* cotton wilt. There are other parallel situations in most Communist countries.

Because of these restrictions, the Central Committee usually develops "safe" themes of broad agricultural significance. Practical goals are avoided because this is the only mechanism for scientific advancement. By chance, I have preserved a copy of my "Examiner's Report" from my doctoral dissertation. The first words are: "There is no data or information that could be the subject of an invention or a discovery in this work." This clause appeared in the examiner's reports after the USSR joined the International Patent Association. Prior to that date, proven foreign nematocides were analyzed and similar compounds re-synthesized in the Institute of Y. V. Samoilov in Moscow. In this way, the Soviet preparations No. 23 (analogue of farbiate) and No. 93 (analogue of DD) were created. But in the 1950s, the situation changed. The authorities began to fear that Soviet discoveries would be exploited abroad, and it was forbidden to publish nonpatented works that were of any practical value. Since patents can take 2 years, and authors advance partly through publications, they often argue that their work is of no value. Should an author deceive the Commission, he will be cruelly punished. The reader must be aware of this problem in assessing the nature of nematological work currently being developed in Russia.

There are "closed" phytohelminthological laboratories in the USSR, perhaps because Karl Marx connected the first revolutionary movement in Europe with a potato famine. Selected nematologists, earning higher salaries, are actively working on secret subjects in the Ministry of War. It is difficult to find out what they are doing, but secrets do leak out. *Heterodera rostochiensis* and *Aphelenchoides besseyi* are most certainly considered as tools of biological warfare!

Conclusion: We see that nematology began to develop in Russia shortly after it did in the West, and that it has gained much from its counterparts overseas. The international contributions of the Russian

nematologists have been conceptual advances built around the framework of I. N. Filipjev and A. A. Paramonov. Their ideas have continued into the contemporary era where theoretical advances, not practical discoveries, are the politically safe ones.

If I have succeeded in showing the pre-eminent position of my old friend and teacher A. A. Paramonov, then the aim of this article will have been achieved. This review does not discuss developments after 1972, but nothing I have heard makes me feel that there have been significant changes in political or scientific direction since that date.

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