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Genetics, Evolution and Radiation

Crossing Borders, The Interdisciplinary Legacy of Nikolay W. Timofeeff-Ressovsky

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Some Stories Told by N.W. Timofeeff-Ressovsky

Nikolay W. Timofeeff-Ressovsky

About Muller and His Life in Moscow

Our 'coterie'—the Chetverikov[1] Circle—formed our small group into one body and in the mid-1920s it grew to about fifteen young members. The meeting place was usually not at the Institute but at Chetverikov's or in my flat. There was a very big room in my flat. So, a very easygoing circle of nice friends had formed, absolutely informal. It is obvious of course that in the 1930s such a 'coterie' would have certainly been arrested and its members would have gone to prison with a 'dime verdict' (10 years of imprisonment without rights for communicating families) each. I happened to do my time in the Lubyanka[2] jail, in 1945. My cellmates were two young students-mathematicians from Moscow University. Out either of boredom or curiosity, they had started a circle of mathematics. They had been arrested and got their 'dime verdict'. Bingo!

And in summer of 1922 the following thing happened. For the first time an outstanding foreign scientist, with radical and outspoken 'left' political beliefs, already famous at that time geneticist Hermann Muller arrived from America.

Timofeeff-Ressovsky NV (2000) The Stories Told by Himself with Letters, Photos and Documents. Dubrovina NI (comp. & ed). Soglasie Publ, Moscow (Russian).

Some stories told by N.W. Timofeeff-Ressovsky: About Muller and his life in Moscow; "Green Pamphlet"; The isolines of the female beauty (submitted by Moscow State University Lomonosov Scientific Library).

[1]Sergej Sergeevich Chetverikov (1880–1959) is an outstanding Russian and Soviet biologist, geneticist-evolutionist who pioneered synthesis in Mendel genetics and Darwin evolution theory.
[2]The State Security Committee on Lubyanka Square.

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Muller was one of the first oldest disciples of Morgan, from the so-called Ruffians' Four: Morgan, Sturtevant, Muller and Bridges. Muller arrived in Moscow by aeroplane, I mean he, of course, crossed the Atlantic ocean by steamer, in tourist class which is cheaper. From Harve he flew by aeroplane to Munich, then, as far as I know, from Munich to Warsaw and from Warsaw to Moscow. Quite a journey I would say. He brought from America a huge collection of cultures, wild cultures of various mutations and combinations of various mutations. By that time, a couple of hundreds of mutations of a glorious, actually unique, wonderful genetic object—the fruit fly *Drosophila melanogaster*—had been discovered and studied. Muller made several reports, visited our biological stations at the institute. Thus, he showed personally the technique of drosophila handling, how to work with it in laboratory. It was all entertaining, exciting and quite interesting.

I must say here that before the arrival of Muller I had to work a little with species caught in the Moscow region instead of *Drosophila melanogaster*, in the company of Dmitri Dmitrievich Romashov[3]—also a young man who had just graduated or not graduated from Moscow University in the speciality of entomologist, who later became one of outstanding geneticists of the Chetverikov Circle. On our own, according to literature, we got cooking the feed-stuff for drosophila going, as well as the reproduction technique, mercy killing flies with gas to study them under the microscope or with lens. So for us two it was not absolutely new but, nevertheless, useful. Knowing elements, we learned from Muller, in a manner, all modern for that time technology of drosophila breeding as a test object.

Muller read several reports to us. And anyway, he had quite a good time and chatted a lot. He visited both our stations: in Zvenigorod and in Anikovo. On those occasions, there were lavish sprees, even Koltsov,[4] and Serebrovsky,[5] manoeuvred and fetched a whole box of Champaign of the Abrau-Durso brand. The Champaign was delicious! And of course, pure alcohol. There were binges, and it was very exciting. Muller is a very talented and interesting man, indeed. We became big friends later.

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[3]Dmitri Dmitrievich Romashov (1899–1963)—geneticist. Until 1942 he worked at the Institute of Experimental Biology, then at other Institutions. He was a population geneticist.

[4]Nikolai Konstantinovich Koltsov (1972–1940) is a Russian biologist, zoologist, cytologist, founder of the Russian Soviet school of Experimental Biology. Koltsov is the author of the fundamental idea of template synthesis of chromosomes. Corr. Member of the St. Petersburg Academy of Sciences from 1916 (Russian—from 1917, the Academy of Sciences of the USSR—from 1925), Acad. of the Academy of Agricultural Sciences (1935).

[5]Alexander Sergeevich Serebrovsky (1892–1948)—biologist, one of the founders of the national genetics, Corr. Member of the USSR Academy of Sciences (from 1933), Academician of the Academy of Agricultural Sciences (1935). Scientific directions of his investigations were general genetics and animal genetics. Serebrovsky formulated and experimentally confirmed the idea of the divisibility of the gene. He proposed a scheme for the linear structure of the gene and the method of determining its size, as well as a new direction in the theory of evolution—geno-geography. Serebrovsky contributed into theory of selection. He was the founder and first head of the Department of Genetics of Moscow University (1930), and one of the founders of the school of Russian geneticists.

Afterwards he came at the invitation of Vavilov—in 1934, 1935, 1936—spent three years here, first in Leningrad, then in Moscow, at the Institute of Genetics of the Academy of Sciences, in the group of Nikolai Ivanovich Vavilov. He learned to speak Russian fairly well and from Hermann Muller turned into German Germanovich, as his father was also Hermann. And then, in 1936, he showed a clean pair of heels. It was absolutely clear to him even in 1934 where everything was driving at. He put up with it until the end of 1936 and then was just in time to flee. In 1937, despite his American citizenship, it would be surely unsafe for him to stay here. At any rate, many people could have been arrested because of him. He put two and two together and took off home.

He read his reports to us in German. He had found out that only few of us knew English… very few. Even today young people do not know English, and do not have any idea about other congress languages—French, German and other. At that time back there remained a generation who had studied at illustrious schools and they spoke fluent French and German. Those who didn't have practice could not speak but could read and write and of course understood everything. English was not obligatory for us at school, and far from many pupils studied the English language. I had English at school. Muller quickly found out that nobody knew English, but he knew German and was absolutely sure that he spoke fluent German. The thing was that 'Menchen und Weibchen' he pronounced as 'Monchen und Wobschen'. Our listeners were bewildered at first what those 'Monchen und Wobschen' could the drosophila have. The words actually meant fly males and females. That's it.

Well, in 1922 a very significant thing happened: we contacted, personally, the most advanced at the time genetics group, the Morgan group, straight via Muller. Our primary task in connection with introduction of the most modern for those times experimental drosophila genetics into our circles was the necessity of thorough mastering the literature which had been absolutely unfamiliar to us before. In 1921 Koltsov received a book of Morgan "Structure basics of heredity"[6] sent to him by his friends in Germany. It had once played a great role in genetics. And it was, actually, the beginning of introduction of modern genetics into biological insight of Russian zoologists, botanists, microbiologists, etc. And only from 1922, or even 1923, scientific journals started arriving, especially on genetics, which had been in complete oblivion for us all before.

Muller brought not only live cultures of drosophila but also a great number of reprints on drosophila, corn and other papers. So, we set to an extremely important, detailed abstracting with a full critical analysis of those new genetic papers. In this regard, our coterie ceased to be a simple 'Soor' (translation from Russian: abbreviation of Russian words 'sovmestnoe' joint and 'oranie' shouting) and was entitled 'Drossoor'—joint shouting about drosophila.

Aside from everything else, for all of us it was the best school to apprehend and study scientific literature. Because our coterie was, as I have said, an informal one we could feel absolutely free and could freely annoy each lecturer with questions of

[6]The Physical Basis of Heredity by Thomas Hunt Morgan.

all sorts. So any lecturer, while delivering his report or a review of several papers, or a regular summary, had to be able to give an account of any issue we posed to him. It certainly played a big role in our further scientific progress. The leadership of Chetverikov in our completely free and democratic circle was another very important factor. Somehow he could direct all arguments, conversations that seemed to become sometimes absolutely vague, formless and chaotic into the necessary topic, but he never imposed any restrictions, either on the lecturer or the audience, in this way leaving us free for discussions and gabbing and preventing these arguments from vain talk. It seems to me now that all members of 'Drossoor' regard this 'Drossoor' school as great experience we had in 1921, 1922 and 1923.

I would like to mention once more the fact that from our juvenility to 1922 we were cut off absolutely from everything that was abroad. Genetics at that time was quite a young science and it was most interesting and viable. The period of vehement development of experimental genetics was roughly saying from 1913 to 1922–1923. That meant that we naturally could not follow its development, say nothing take part in it. We had only one or two years to catch up with it in our 'Drossoor', apprehend it and 'chew' it over. It certainly turned out right that we started parallel experimental research on this wonderful, most suitable object for experimental genetic studies, especially at that time—*Drosophila melanogaster*.

«Green Pamphlet»

Last time I tried to do my best to tell how we had joint a very exciting circle of people, mainly physicists, partially physicists-chemists, who were busy composing a new physical description of the world and new theoretical physics. In those times, just since the end of the 20-s in Copenhagen Bohr's group, first of all, they were developing the quantum theory and unification of the quantum theory with the relativity theory and the general principle of relativity. In the 30-s an absolutely new atomic and later nuclear physics began intensively to develop experimentally: neutrons were discovered and obtained a wide recognition, new and new elementary particles appeared. Thus, an extremely exciting epoch began in the history of physics.

The post-war time is often considered to be remarkable in the development of physics. I do not agree with this opinion completely. Now it is the time of the development of physics application activity. Now different discoveries in physics made at the end of 20-s and 30-s until the beginning of 40-s, are being introduced into practice. That time was indeed famous and extremely exciting. Now all this is transferred to machinery.

We have overcome the whole era of the atomic physics. What good has remained after it—is still too early to speak about because, well, several of these atomic electric power stations and the atomic station of desalting the sea water—all these are trifles, finally. But there are very many horrible things, of course: atomic bombs, nuclear bombs, hydrogen bombs which partially were realized

experimentally and spoiled rather strongly the biosphere of the Earth. Now they are no explosions any more, at least, not so visibly and noticeably.

Then came the cosmic or "cosmetic" era in which we still live. Here there is even less new and unexpected going. And to what exciting things it will lead—still it is difficult to know. Maybe, the most exciting new what this "cosmetics" has brought with—is American and our long lasting but rather boring experiments on these orbital stations where some gentlemen were sitting for about 2 months and longer expecting the increase of their earth income being busy with the production of little lice and other insects. Nothing super exciting was discovered there. Unfortunately, American or our specialists almost didn't carry out gradually planned experiments and performed mainly whatever they had to do.

And again it cannot be compared with really great scientific discoveries which took place in 20s-30-s years of the 20-th century. Thus, for me, my group, the group of friends, employees, my students—it was a great luck that since the end of the 20-s and, especially, in the 30-s we managed to get into science just in the most interesting period of time, maybe, of the 20th century, in development of the natural sciences.

I very much hope that this new period of flourishing of the natural science in the 20th century will fruitfully impact on, first of all, philosophy and, second,—on many humanitarian disciplines. No doubt that some humanitarian subjects will have to change for a new manner not to turn out to be useless for all. But I believe that it will happen not so fast as the new reconstructions of the physical pictures of the world in the natural science. It will happen more gradually as a whole line of general methodological and, partially, of the philosophical principles of the modern natural sciences, not physics or biology, but just the natural sciences in general. At first, they will step by step be popularized to become "eatable" and understandable to the scientists who do not belong to the natural sciences or mathematics. Then they will penetrate the circles beyond the natural science and mathematics. Then, probably, we will enjoy the same new intensive exciting period in the development of humanitarian sciences on the Earth. It is possible. But all this belongs to the future. God knows. To predict is not good because you can "get into the sky with a finger"—that often happens.

Now I would like to speak about my own business. One of the three scientific directions which were developed in my division at Buch—as I have already told, is a quantitative study of the mutation process. And performing the study of the mutation process there was an attempt to create at least the most common picture of the origin of genes. If to get to know something substantial how something unknown to us is changing it means that we have already known something about this unknown to us. Thus, having found some regularities in the mutation process, it is possible to formulate some statements about the origin of the genes themselves whose changes are mutations. This is the main idea which was the basic of the joint discussions, discussions of genetics specialists, biologists, true biochemists and, what is the main thing,—of the physicists-theoreticians.

I have already mentioned that in my division at Buch this scientific direction was born not like a bubble on the marsh but it was the logical development of one of the directions established by my teacher Nikolai Konstantinovich Koltsov

at the beginning of the century. He tried to do his best to create for himself some kind of a theoretical model of what chromosomes and genes are which are located lineally as it was known in these very chromosomes. He developed this on the basis of his experimental cytological studies where he investigated the influence of definite physical-chemical conditions on the form, structure and motion of cells as well as on the basis of the general discussions concerning the inherited elementary factors and genes. We used Koltsov's basics that chromosomes must be by definition extremely constant resistive compositions which determine all life especially of the cells and any joints of the cells. It means that it was already in those times clear that chromosomes are basics of what we call today the code of the heritage information. That is why Koltsov imagined the chromosomes as structural physical-chemical compounds, gigantic micelles, more probable, gigantic molecules of some more or less autonomic parts whose structural sub-divisions are genes lineally located in these long gigantic chromosomes. We were occupied with the studies to obtain mutations experimentally by exposure of the flies-drosophila with gamma-rays and other ionizing radiation. We—me in collaboration with physicists—theoreticians of the type of Max Delbrück as well as radiation physicists-experimentalists like my employee Zimmer and some young people who participated in this common activity which was very wide in range and huge in quantity of the data being processed. We tried to carry out the following.

Varying the conditions of exposure we tried to obtain the results from whose comparison it would be possible to conclude in the most common form what processes are the basics of the mutation origin, i.e., what do mutations mean? From physics it is exactly known that ionizing radiation can perform what other types of radiation cannot, and if to vary parameters, doses, rigidity of the ionizing radiation there must be consequences of these ionizing types of radiation. That is why during several years since we did not have other opportunities and methods we concentrated our work in this direction.

We carried out a huge volume of work. Just during those very years about, probably, ten or 15, I studied totally a couple of millions of flies and collected a rather big number of data on the direct and reverse mutations. One of the important some kind of criteria of the gene structure in the most general form, i.e., whether this structure is multi molecular or monomolecular, is an opportunity by one and the same method, say, by one and the same x-ray exposure, to cause mutation of some gene and its reverse mutation—from the mutation state back to the initial one. This is a very simple thing. Together with Muller once in some talk we formulated this way. Who did it, don't remember. Muller or me… More probable, it was Muller, in those days I was younger and sometimes felt ill at ease to chat like that but he already didn't. So, imagine this picture the following way: if the mutation were a simple quantitative damage of the gene, well, for example, a piece of the gene was bit out, then, of course, it would not have been possible to cause either direct or reverse mutations by one and the same x-ray exposure. It is like—you cannot break a window by a feast and by the same hit of the feast the window would have jumped back on its place.

From the comparison of action of different doses of the same rays and the same dose of ionizing radiation different on rigidity it is possible to clarify rather precisely whether the effect which we observe is a mono molecular or multi molecular change. We got a picture again was for the favor of a mono molecular change. That is why by the middle of the 30s we came up to some hypothesis that mutations caused by exposure are mainly relatively simple mono molecular reactions. Thus, logically it follows from the above that genes themselves must be of some what, if you like, simple physical chemical units.

Though, of course, they can be very complex. Simplicity and complexity are the notions which are rather indefinite. "Simple" I say in this case in the sense that they do not consist of combinations of different molecules forming some complex substance: some lubricant, tar, or butter, or something else. They are physical-chemical structure units, evidently, gigantic molecules or micelles or parts of a more or less autonomous, some very large micelle composing a whole chromosome which can be seen in microscopes. So, that was a simple picture we obtained—simple in the sense that it could be easily studied further. The first short overview was published by me in 1929, the second one, significantly thicker,—in 1931, and then the other one, even thicker,—in 1934 in "Cambridge philosophical bulletins". In 1935 we three—me, Zimmer, and Delbrück issued a publication in the so called "Göttingen funeral of the first class"… In Göttingen there was a famous (still exists) Göttingen Academy which is called not Academia but a Göttingen Gesellschaft der Wissenschaft, or when they feel boring they change the title for Gesellschaft der Wissenschaft zu Göttingen. They issue such green little note books where they published more or less long detailed reports made in that very society. It is still has the title of the classical one because of the respect towards our point of view concerning the mechanism of mutations.

Then after the end of the war it became clear that chromosomes and, consequently, the genes sitting in them are nucleoproteids. And the whole army of biochemists rushed to analyze and clarify the structure of those nucleoproteid compositions which form the basis of the chromosomes and then, logically, of the genes.

This was rather rapidly developing. Here the main theoretical brain work was done in England by a physicist Crick, and the main thing, I say, the chemical option was carried out in America. By the end of the 40s and in the 50s all the cream of the European science was concentrated there: everybody who managed to have snuck out there even during the war and many specialists—after the war. So, the American science began to flourish, still it is flouring till now, they say. Well, now, indeed, it is already the remains of the European big science.

In the second half of the 30s my friend and employee Max Delbrück moved to America, as I told you, a theoretician by background, but I introduced him to biology. A big number of American cytologists and European cytologists and biochemists who socialized in America fell under his theoretical influence. So, there was such an international group organized in the 50s whose core consisted of three individuals—an Englishman Crick, American Watson and a Russian physicist

Gamov, as abbreviation in Russian we called them "crick and gam" which means in Russian "shouting and noise".

Then this group was growing and growing, it meant that really famous analysis of the chemists began, true analysis, analysis of the macro molecule structures. Now by means of the Nobel prizes this splendid, indeed, organic analysis is going on, the analysis of the structure of gigantic protein molecules and nuclide acids.

There are all grounds to assume that in the near future the physical-chemical structure of the heritage information code will be determined with a rather sufficient precision. Now we are, certainly, still far from it. And only post graduates suppose that molecular genetics has already been perfectly built. In fact there is still no molecular genetics. My personal scientific and, in particular, experimental relationship with this part of genetics, with the study of the mutation process, general principles of the structure of genes and chromosomes, has been, so to say, completed. Personally since the 40s I have not been occupied with this. It is true that many people, especially, abroad consider me to be something like a granddad of this scientific direction because a new after-the-war version was issued by Delbrück: in the 30s I inserted into his brain some necessary substantial thing. So, everything started from this, from this very classical, our so called "green little notebook" of the Gottingen Society of Science. Let it be so, let it develop for good health.

The Isolines of the Female Beauty

Have I told you about the Copenhagen method—a mathematical study, precise, isokal, of isolines of the female beauty? Or haven't I? It doesn't lead to the subject beyond our topic, it is the most important option. Everything leads to micro evolution finally.

So, there [in Bologna at one of the plants of electro-technical equipment] there are absolutely amazing beauties in the assembling halls. Besides, in each hall they are dressed in a specialized uniform. In one hall all these beauties are in white uniforms, in the other—it is of the ivory color, in the third—they are in yellow, in the fourth—somewhat greenish, pink, blue. Each hall has its own color. All these clothes are sewed lovely, the waist is taken over with a little belt, they all are very nicely built, charming, good-looking faces and etc. How do these engineers live there? God knows! In this concentrate of such beautiful females! And it is not a surprise because the study, precise, of isokal has shown that one of the highest picks of the female beauty is located to the north from Florence, in Bologna itself, and in Dalmatia, in Yugoslavia. Three unreachable picks.

It was offered, I think, for the first time by a Russian physicist Gamov. He seemed to be the first one who suggested; "We all are interested … more or less, in good females, and etc. There are some strange people who insist: "Oh, there are many good-looking women in Paris." But this is assumed absolutely indefinitely, non-critically, not precisely. But the female beauty as everything else can be easily

and simply studied statistically". So, a simple method was developed. Physicists-theoreticians, and in general, theoreticians like me, it means all the participants of the theoretical Copenhagen circle used such little note-books, well, like the ones used at school for foreign words. And where ever they got together and without any dependence on when they got together going or walking along the streets, being at restaurants, at cafes—it didn't matter, they put down estimations to the ladies whom they met on their way using a five-point scale with pluses and minuses. They put down the date and the place. All regions of Europe were distributed. We didn't take into account America, Africa or other continents. The Soviet Union was excluded due to political reasons: nobody was let in, nobody of the descent people gathered there, and it was unknown what was going on in the Soviet Union.

Each big region was under responsibility of one or two famous theoreticians. For example, Niels Bohr and his deputy Weiskopf were in charge of Scandinavia—Denmark, Sweden, Norway, Iceland… Then Chadwick and Blackett—two famous theoreticians and atomic specialists were in charge of England and Scotland, Ireland and, it seems to me, also of Holland. Pierre Auger and Francis Perrin, French, were in charge of France, Belgium. Then Rossetti—a wonderful Italian theoretician who knew so much about bugs and amazingly much about ommonites (archeological shellfish), he was in charge of Italy and Balkan countries.

Then Schrödinger was in charge for Austria, Czechoslovakia, Hungary and Switzerland, Heisenberg and Jordan—of Germany and Poland. Thus, all Europe was divided. It means that the leading scientists were collecting the data which were treated by absolutely first-class mathematical processing at the highest level. And the bosses—theoreticians on the basis of this processing—built isokals. For many countries it became possible already by the beginning of the Second World War, there was enough of the obtained data. Isokals—it is just the same as isobars or isotherms–isolines. Only isotherms are the lines connecting the points of the same mean temperatures, and isokals (derivative of the Greek "kallous"–"beauty") are the curves connecting the points of the same mean female beauty.

Rosetti has a study at Rome University in some ancient palazzo. It was an extremely high ceiling room and on one of its walls on its full size there was a hanging map of Italy and the attaching part of Balkans, Yugoslavia and Greece. This map was marked with the isokals. Very high picks, on the average they were a little bit lower than the "excellent" mark, but higher than the "good" mark with a plus, located also in the region of Florence and to the north of Florence in the Northern Toscana. The areas around Milano—it was also a "good" mark with a plus, on the average. The "excellent" mark with a plus was given in exceptional cases and required a special investigation "with passion". So, a very high pick—it was Bologna, then came the district Splita in Dalmatia, and—in the north from Splita in Albania.

And you who know the world mainly from the refined fiction have very often an absolutely false picture: "Oh, Italian ladies! Oh, Italian ladies!" To the south from Rome and in Rome itself, Italian women are a mixture of a frog with a monkey, speaking in general. When they are 15 years old—they are "more or less", by 25 years she weights already 100 kilos, you see, and even more "with a tail", she

crawls out of all her skirts and, it is not clear what she had on her face being younger. Horrible! And among older southern Italian ladies there are, visa vice, there are absolutely dried out bones, covered with skin, just live witches. That's it! It is very sad, by the way, concerning Paris and France. Again because of our fine fiction which mixes sometimes beautiful clothes with the content in the beautiful clothes. In Paris the women's fashion is world-known concerning elegancy, and not in vain! But French women, in general, are not famous of the beauty, and sometimes, of elegancy either. Thus, do not trust the fine fiction in everything, it often just lies.

There is a very high pick in the Southern meadow Ireland, to the south from Dublin.

It was known long ago without any special proof that Irish women sometimes are amazingly beautiful. As I remember, someone put a couple of "excellent" marks with a plus in spite of the freckles on the face. This is a special phenotype—reddish hair, and even red, with green eyes, they are perfectly beautiful, just an "excellent" mark! Then there are very high picks in Norway. But in the Southern Norway there are also gaps. German women in some areas of the Southern and Western Germany are not at all good-looking, to tell the truth. But Prussian women, especially, in the north and north-east on the borderline with Poland sometimes can be given an "excellent" mark. And there the mean isokals were rather high because of this. In the Eastern Poland, also, but this is because of our Russian influence, though in Poland there are awful gaps that is why to relate the picks of the isokals directly with the country in general is very complicated. In all the more or less large countries without any exceptions there are picks and gaps, maybe, except Yugoslavia. There the highest picks are located in Dalmatia, but there is one or two picks in the old Serbia as well. There are very beautiful Serbian women with grey eyes and dark hair there like we have in the southern part of the Great Russia. So, I have presented to you the results of a large theoretical scientific investigation!