

Born

6 April 1947
Berlin, Germany

Current Position

Distinguished Professor
Department of Entomology
University of California–Riverside

**Refereed Publications, Reviews,
and Book Chapters**

207
34 in *Nature*, *PNAS*, or *Science*

Highly Cited Publications

Molecular Characteristics of Insect
Vitellogenins and Vitellogenin
Receptors
(with Tom Sappington)
524 citations

Genome Sequence of *Aedes
aegypti*, a Major Arbovirus Vector
(with 94 co-authors)
1,228 citations

Mentoring

Graduate Students: 23
Postdocs: 48

Service

Editorial Board
Annual Review of Entomology
(1998–2003)

Editor
*Insect Biochemistry and Molecular
Biology* (1999–2006)

Honors

Outstanding Research Publication
Zoological Institute of the Russian
Academy of Sciences

Recognition Award in Insect
Physiology, Biochemistry,
and Toxicology
Entomological Society of America

Distinguished Faculty Award
Michigan State University

Mir S. Mulla Chair in Entomology
Department of Entomology
University of California–Riverside

Presidential Chair
University of California

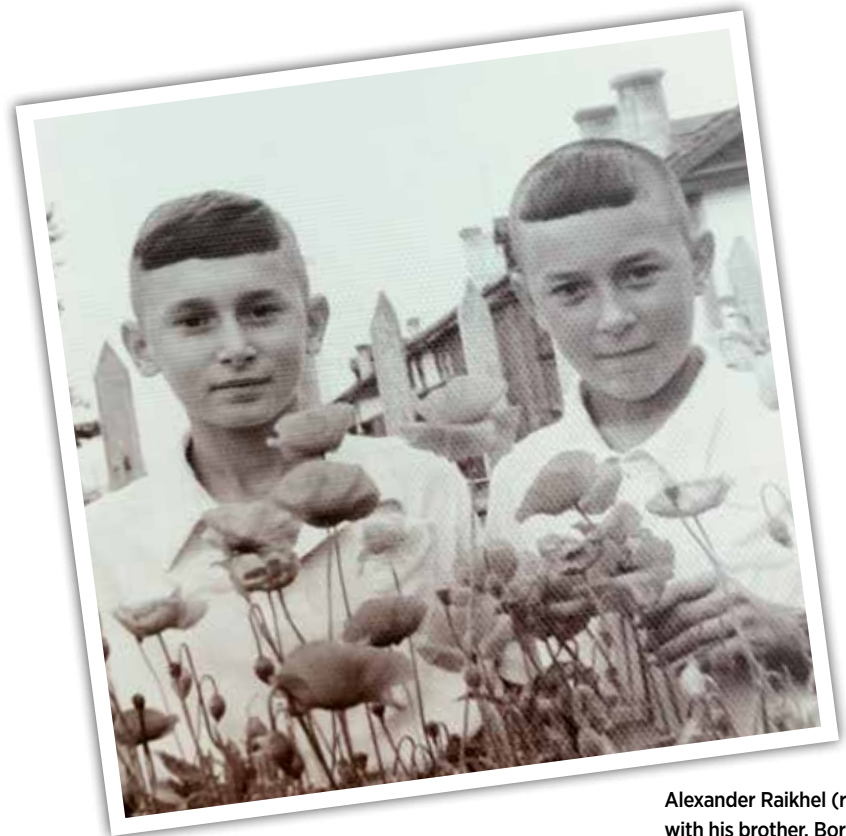
NIH MERIT Award
(2002–2012)

Elected Member or Fellow

American Association for the
Advancement of Science

Entomological Society of America

National Academy of Sciences
(USA)



Alexander Raikhel (right)
with his brother, Boris,
in their father's garden,
Siberia (1962).

Alexander Raikhel: Russian Nightmare, American Dream

Marlin E. Rice

When Alexander Raikhel fled the oppressive atmosphere of the Soviet Union with his wife and son in 1979, he arrived as an immigrant to the United States with almost nothing in his pocket except the anxiety of an uncertain future coupled with the promise of new-found freedom. A year earlier, the family had survived a violent airplane crash that killed several passengers and injured many others. The Soviet airline claimed that there was no crash, but that the plane had made an “unexpected landing.” Reluctantly, the airline compensated the Raikhels 150 rubles for their 150 kilograms of lost luggage, which mostly was fresh vegetables because none were available

in Leningrad, where they lived. The crash experience, the everyday struggles of Soviet life, and the increasing anti-Semitic discrimination the family was experiencing catalyzed their decision to emigrate. Thirty years later, that decision had been professionally affirmed: Raikhel was named a distinguished professor of entomology and elected a member to the National Academy of Sciences (USA).

Growing up in the former Soviet Union, Raikhel was educated in two prestigious universities in Russia. He earned a Master of Science in Zoology–Parasitology (1970) from Leningrad (St. Petersburg) University, and his Ph.D. in Parasitology (1975) from the Zoological Institute of Russian

Academy of Science. For his doctoral research, he conducted an electron microscope study of the internal ultrastructure of the ixodid tick, *Hyalomma asiaticum*, which resulted in eleven published papers and two book chapters. Upon arrival in the U.S., Raikhel joined the laboratory of Arden O. Lea, a well-known mosquito physiologist at the University of Georgia, for a six-year postdoctoral appointment. It was here that seminal experiments in mosquito ultrastructure during reproduction were formative in determining the direction of Raikhel's future research in mosquito physiology.

In 1986, Raikhel joined the Department of Entomology at Michigan State University as an associate professor, attained the rank of professor in four years, and ten years later was honored with a distinguished faculty award. He departed Michigan in 2002 for California and the Department of Entomology at the University of California–Riverside. Three years later, he became the founding director of the Center for Disease Vector Research at UC–Riverside, where he continues to conduct research and mentor graduate students and postdocs.

Raikhel is internationally recognized for his studies of mosquito reproductive biology and for uncovering major mosquito immune pathways, operating with uninterrupted National Institutes of Health (NIH) support for over 30 years. Each NIH-supported grant has resulted in multiple peer-reviewed publications, many of which contain seminal findings. His research has made significant contributions toward understanding mosquito reproduction at the cellular, biochemical, and molecular levels. His laboratory was the first to purify, clone, and characterize the insect (mosquito) vitellogenin receptor, and his research identified microRNAs that play critical roles in regulating vital functions such as blood digestion and egg maturation in mosquitoes. He has uncovered the molecular mechanism underlying the blood-meal activation of female reproductive processes, demonstrating that it is based on amino acids and the target of rapamycin kinase. Work from his laboratory has also contributed to the understanding of mosquito metabolism, and it was among the first to establish mosquito transgenesis. His laboratory pioneered the binary Gal4/UAS system in the mosquito *Aedes aegypti*. Recently, they successfully



Alexander Raikhel, Distinguished Professor of Entomology, University of California–Riverside (2022). (Photo by Marlin E. Rice.)

utilized CRISPR-Cas9 to mutate several genes of interest and tag others for visualization in *Aedes aegypti*. Of particular importance is the successful utilization of CRISPR-Cas9 approaches for the analysis of insulin-like peptides in *A. aegypti*.

Raikhel, age 75, was interviewed on 18 May 2022 at his home in Riverside, California. This interview has been condensed and edited for clarity.

Rice: How did you survive through the recent coronavirus pandemic?

Raikhel: Actually, it was productive time. There was no obstacle to doing science. Working with manuscripts, reading scientific literature, learning. That's what I love to do. I had regular Zoom meetings with the members of my lab. Together, we wrote several manuscripts and published five papers, with four of them in

PNAS. Zoom teaching was also effective. In addition, my friends and I had a Zoom wine gathering once a week. I like classical music, and in my free time, I listened almost one hundred operas.

You have a strong Russian heritage. Tell me about family.

My mother, Valentina, was born in a small place near Leningrad [St. Petersburg]. She became a surgical nurse and worked at the Medical Military Academy. Soon after the World War II started, she found herself in the Leningrad siege that lasted almost 900 days.¹ My mother was only 20 years old when the war started. The siege was a horrific experience, imprinted forever in her personality. During starvation, personnel of the academy survived because of laboratory animals. First, they ate rabbits, then cats, and finally rats.

Your mother ate cats and rats?

Of course, nothing else to eat during the siege. This saved her. At the end of the siege, the Soviets established a road through the ice-covered Ladoga Lake, called the "Road of Life." My mother, together with thousands of other starving inhabitants of Leningrad, was taken from the city by a truck through the Road of Life. It was very a dangerous journey because Germans bombed the road; it was covered with holes and trucks were disappearing through the ice. She was successfully transported to the Caucasus where, after recovery, she was drafted to the army.

My father's life story was different. He, Simeon, lived in the city Vitebsk, which is now in Belarus. He studied in a medical school and graduated as a surgeon. The sad story was that his mother died of starvation and father was arrested and killed during Stalin's "Great Purge" of the 1930s.² The family suffered terribly, being treated as the "enemies of the people." At the beginning of World War II, my father went to the army as a medical doctor. There, my

¹THE SIEGE OF LENINGRAD WAS A PROLONGED MILITARY BLOCKADE (872 DAYS) UNDERTAKEN BY THE AXIS POWERS AGAINST THE SOVIETS. IT CAUSED EXTREME FAMINE THAT RESULTED IN THE DEATHS OF UP TO 1.5 MILLION SOLDIERS AND CIVILIANS, AND THE EVACUATION OF 1.4 MILLION MORE (MAINLY WOMEN AND CHILDREN), MANY OF WHOM DIED DURING EVACUATION DUE TO STARVATION AND BOMBARDMENT. THE SIEGE OF LENINGRAD RANKS AS THE MOST LETHAL SIEGE IN WORLD HISTORY, AND SOME HISTORIANS SPEAK OF THE SIEGE IN TERMS OF GENOCIDE, AS A RACIALLY MOTIVATED STARVATION POLICY THAT BECAME AN INTEGRAL PART OF THE UNPRECEDENTED GERMAN WAR OF EXTERMINATION AGAINST POPULATIONS OF THE SOVIET UNION (WIKIPEDIA 2022A).

²THE GREAT PURGE WAS AN EFFORT BY JOSEPH STALIN TO ELIMINATE POLITICAL CHALLENGES FROM PAST AND POTENTIAL OPPOSITION GROUPS, INCLUDING THE LEFT AND RIGHT WINGS. THE TOTAL ESTIMATE OF DEATHS BROUGHT ABOUT BY SOVIET REPRESSION DURING THE GREAT PURGE RANGES FROM 950,000 TO 1.2 MILLION, WHICH INCLUDES EXECUTIONS, DEATHS IN DETENTION, AND THOSE WHO DIED SHORTLY AFTER BEING RELEASED FROM THE GULAG AS A RESULT OF THEIR TREATMENT WHILE IMPRISONED (WIKIPEDIA 2022B).

parents met and worked together in military hospitals throughout the war. They married after the war when they were stationed in Germany.

Your parents moved back to the Soviet Union after you were born.

Yes, I was probably three years old when we moved from Germany to Azerbaijan, which was a part of the Soviet Union at that time. Three years later, my father was transferred to Krasnoyarsk, a large Siberian city. Then further east to a smaller city, Nizhneudinsk. Finally, we ended up in the inhospitable area of eastern Siberia bordering China and Mongolia. The place did not even have a real name, just a railway exchange number, 77. This was a military installation where my father was the head of a surgical department at a large military hospital. It was located close to the Gulag [forced labor camps], famous for keeping political prisoners in the Soviet era. We were living in ugliness in Siberia. A terrible, terrible place.

Why do you say Siberia was terrible? Describe the experience.

I should stress that I refer here to our last place of living in Siberia. First, the climate was harsh with extremely cold winters, minus 40–50 Celsius, and constant, strong wind, penetrating to your bones. We lived in a dilapidated house without any conveniences: no running water, no indoor plumbing, no indoor toilet. Going to the outhouse on such days was a great challenge. [Laughs.] That is what was available to a high-ranking officer and a doctor! By mornings, the temperature in the house would drop to below zero Celsius and water freeze. Early every morning, my father used to start the fire in a large stove before my brother and I could get out of our blankets. When I was 15, we finally left this place for the European part of Russia.

You're in Siberia from age 6 to 15. What did you do as a young boy?

These were formative years. I was interested in biology as long as I remember myself. All living and moving creatures fascinated me. I had rabbits, pigeons, hedgehogs, and fish. I was spending hours taking care of my animals. I liked reading about travelling and nature. I was probably 13–14 when I read Darwin's book about his trip on the *Beagle*.



“WE WERE LIVING IN UGLINESS IN SIBERIA. A TERRIBLE, TERRIBLE PLACE.”

This is the book *The Voyage of the Beagle*?

Right. This book sparked my imagination: I dreamed about travelling and studying animals. I have never met scientists, but in books most of them wore glasses. Thus, I concluded that to become a scientist, I needed glasses. [Laughs.] I was a middle school boy then, so I told my parents, “I don't see well.” My father took me to his hospital. An ophthalmologist checked my eyes; there was nothing wrong. I was crushed because my dream of becoming a scientist had vanished. [Laughs.]

Did you ever get glasses as a young boy?

No, no. I was 27 when I got my glasses. I was finishing my Ph.D. degree then.

You were obviously interested in science. Did you have an interest in insects at an early age?

Yes, among books on insects, I read the one by [Jean-Henri] Fabre. It had fascinating stories about insect behavior, masterfully described by Fabre. And I was so involved. During short Siberian summers, when the steppe [prairie] was covered with green grass and yellow lilies, I went there to observe insects. I also made an insect collection, tried to identify these insects and read about them. Some insects that I collected turned out to be very rare, from so distant land. Later, these specimens ended up in the museum of Leningrad University.

You attended Leningrad University, which is now called St. Petersburg's University.

Yes, I did. It was originally named St. Petersburg's University but renamed to Leningrad University after the Communist Revolution. Now, it is back to the original name.

Did you have any challenges at the university?

As any other student, I struggled with some subjects. Overall, however, I performed very well. The challenge was to be accepted to the university. I was very well prepared after graduating from a specialized math school. I received high scores on

exams but was not admitted because I'm Jewish. There was a strict quota for admitting Jews to Soviet universities. So I got to the evening division, and I needed to work. I found work in Leningrad Zoo.

That was probably good, as a biologist?

Yes, yes. I had a little horse and was delivering food for animals. So this was my job. During my break, I could observe animal behavior. An African black rhinoceros befriended me, and in exchange for some carrots, she rocked me up and down while I was standing on her head. I was 18 years old and could balance very well standing on the rhino's head. I think that it was fun for both of us.

This was the job that provided income so you could eventually get to university?

My work was from 5:00 a.m. 'til noon, and after this, I went to the university. There is a custom in St. Petersburg: the cannon fires at noon from the St. Peter and Paul fortress. That was the sign for me to quickly run for the university. I attended both the daytime and evening classes. In addition, I worked on the laboratory practicum at the Department of Invertebrate Zoology. I would come home by 10–11:00 p.m., and at 5:00 a.m. my work started.

You got less than five hours of sleep a day?

Yes, it was a challenging time for an eighteen-year-old teenager. However, I worked very hard, received excellent grades for all classes required for the day and evening divisions, and was transferred to the regular daytime division.

You skipped the bachelor's degree and went to a master's degree. That seems unusual.

It was a five-year program at the College of Biological Sciences at Leningrad University. The requirements included taking a year of math and physics, two years of six kinds of chemistry, and of course numerous biological courses during the entire five-year program. Summer semesters we spent at biological stations, studying entomology, marine biology, genetic analysis, and other subjects. The last three years were dedicated for research for master's thesis. It was a very well-designed system and I enjoyed it tremendously.

However, you have to decide by the end of high school whether you want to become

a biologist, chemist, physicist. Moreover, if you apply to the Biological Division, you must choose between general biology, biochemistry, biophysics, or genetics.

You must decide your career path while in high school?

Yes. It took a lot of maturity. Many students were not ready for such a system and tried to change programs, some even quit. However, because I was determined to become a biologist, the education was fun and exciting.

Then you pursued a Ph.D.

The undergraduate education was free in the Soviet Union, but we were obliged to stay at the same workplace for three years. I was recommended for a Ph.D. program at Leningrad University. However, I was denied admission. Again, my Jewish last name became an obstacle. Eventually, I received a job as a lab technician at the Zoological Institute of the Russian Academy of Sciences [RAS] in Leningrad. At that time, Professor Yuri Balashov, a famous acarologist, was organizing the laboratory of cytology and electron microscopy at the institute. He hired me to assist him in establishing the lab. I went for training in electron microscopy to the RAS Institute of Cytology. Working with ticks, I started to appreciate the amazing transformation that these important disease vector animals undergo during blood feeding and

reproduction. That was the real beginning of my scientific career. Before I left the Soviet Union, we finished a book on the ultrastructure of ticks that later, when I was at Georgia, I translated to English, and it was published by the Entomological Society of America.

I've read where you and your wife and son were on a flight from Azerbaijan back to Leningrad on a commercial Aeroflot flight that crashed. Describe that experience.

Well, it was terrifying. [Laughs.] Our son, Eugene, was three years old. I took a short vacation because my wife, Natasha Raikhel, was in expedition on the Caspian Sea. I flew there with Eugene, and several days later, we were returning to Leningrad. It was a Soviet plane, similar in size to a Boeing 737. Between Moscow and Leningrad, the plane started violently shaking, and I noticed that flight attendants rushed to their seats and buckled up. They didn't announce anything, but we were sitting close and so I could observe them. My wife felt badly; I made sure that she was buckled up and prepared for the impact. I was holding Eugene on my knees, and he was crying because of the air pressure change.

The air pressure change was because the airplane was quickly losing altitude?

Yes, of course. The plane trembled stronger and stronger; it was clear that



Alexander Raikhel collecting marine animals during a summer semester at a marine biological station on the Barents Sea (1967).

we were falling down. A flight attendant with the pale greenish face was saying over and over to my son, “Don’t cry, don’t cry. Everything will be over, everything ...” To calm him down, I was reading a book. It was so frightening, but when you have your child on your knees, you must hold him, comfort him, and read a book. My brain was saying, “We’re not going to die, we’re not going to die like this.” Finally, the pilot released the front chassis to slow down the motion of the plane and it loudly “landed” on a potato field. It jumped several times and violently stopped.

Was anybody injured?

Of course. The flight attendants didn’t announce anything; they didn’t check belts. I remember a quite heavy woman who literally flew forward in the aisle! It was terrible. When the plane finally stopped, flight attendants opened an exit door, where there were no landing slides. I grabbed my son and the three of us jumped down. It was like two stories high. But the soil was soft, so we landed without any injuries. Standing at the edge of a potato field, we watched the smoking plane, broken in pieces. It was surreal! A few people were killed and several injured. But by all estimates it was the “lucky” air crash.³

There is a legend that the plane crash influenced your decision to leave Russia.

Yes, it did. It made the thought of emigrating less threatening. We discussed a possibility of emigration prior to the air crash. We talked a lot about freedom and scientific opportunities in the West, about discrimination for us and our son in the Soviet Union. But after the crash, we were ready.

Your wife also had a Ph.D., so with two doctorates in your family, certainly the opportunities were good for you to do science someplace abroad.

Yes, we were hoping for that. Certainly, we had access to international scientific literature and were well informed about the high level of science in the West. However, there was no interactions with scientists abroad. I was denied attending conferences



During a research expedition to Turkmenistan, Alexander Raikhel checked vertebrates, such as this legless lizard, for ectoparasitic ticks (1977).

even in Poland or Czechoslovakia, at that time communist satellite countries, because I am Jewish. Without feedback from colleagues, it was difficult to assess your professional level.

You decided to emigrate. What was your country of choice?

We thought about the United States.

So you and your wife are walking away from positions at the university?

Yes. After experiencing many difficulties, we finally made it. Both of us had permanent positions as assistant professors at the Institutes of the Russian Academy of Sciences. And then, we were leaving and stepping to the uncertain future.

Did you fear Siberian exile if you tried to emigrate?

Yes, [but] at this point, it was better to go abroad and test yourself professionally than to get stuck in the Soviet Union. When I said at work, “I’m going to emigrate,” I was

fired *on the spot!* According to Soviet laws, to be unemployed is illegal, so you were fired and immediately became a criminal! [Laughs.] We were lucky that we waited only for five months to receive the permission to emigrate. Some people waited for years. When you are unemployed, of course finances are limited. You must pay a lot of money for emigration. For example, authorities even stripped us from Russian [Soviet] citizenship and charged 500 rubles per person for this. [Laughs.]

The Russians charged you to take away your citizenship?

Yes! By comparison, my salary as an assistant professor was 175 rubles a month. [Laughs.]

Those 500 rubles would be about three month’s salary.

Exactly. They would provide about three months of living expenses for a family of four. It was a sizable amount. For the family, just to pay for these stupid passports was a year income! [Laughs.] Finally, we managed to get the permission to emigrate, and we flew to Vienna, Austria. And then, we spent four and a half months in Rome.

Well, four and a half months in Rome is not so bad.

Indeed! To be in Rome was amazing! Monuments, cathedrals, art. We were so lucky.

Being Jewish, how did you decide on immigration to either Israel or the States?

This was in Vienna, where immigration officials asked us about where we wanted to go. By that time, we already decided to go to the U.S. So we were sent to Rome for documents processing for entry to the U.S. In July of 1979, we flew to New York, and on to Athens, where we both were going to work at the University of Georgia. It was *hot*; unbelievably hot and humid.

You’re never happy. You were in Siberia where it’s cold, and now you’re in Georgia where it’s hot.

[Laughs.] I never knew such a hot and humid climate. But it was fine, because this was the beginning of our new life; finally, we were living for our American dream! People both at the university and outside were tremendously warm and helpful,

³ON 19 MAY 1978, AEROFLOT FLIGHT 6709 FROM BAKU, AZERBAIJAN, TO LENINGRAD LOST POWER TO ALL THREE ENGINES, POSSIBLY DUE TO ACCIDENTAL SHUTOFF OF THE FUEL PUMPING SYSTEM. THIS RESULTED IN AN ABRUPT PITCH AND ROLL OF THE AIRCRAFT. THE AIRCRAFT LANDED IN A POTATO AND BARLEY FIELD AND BOUNCED SEVERAL TIMES, SEPARATING INTO THREE PIECES UPON CONTACT WITH TREES. TWO TO THREE MINUTES AFTER STOPPING, THE AIRCRAFT’S FUSELAGE CAUGHT FIRE AND WAS DESTROYED. THE CRASH AND RESULTING FIRE CAUSED 4 FATALITIES AND 27 INJURIES (WIKIPEDIA 2022C).

making our adaptation to the new life easier.

When you flew into New York City, did you see the Statue of Liberty?

Yeah, yeah. Of course!

And what were your thoughts?

As any immigrant, I thought about the world we left behind, with all its ills but also with its beauty. Now we were standing in front of this wonderful symbol of freedom, excited but a bit nervous.

Did any of your colleagues in Russia say you were making a big mistake?

Oh yes, we have been told, “You’ll be sweeping streets in New York!” [Laughs.] Many people were saying that we got crazy after the air crash.

That probably scared you a little because there may have been some truth in the warnings.

A bit. The scary thing was the unknown future. Not knowing who you are professionally, and whether you could succeed. How did I know that I would be flying high?

Did you have a scientist at the University of Georgia that was your sponsor?

Yes. Professor Jerry Paulin from the University of Georgia went on sabbatical to the Institute of Cytology, and he worked in the same laboratory with my wife. We told him that we are going to emigrate. When we were in Italy, Jerry wrote to us that there were postdoctoral positions, for Natasha in his lab, and possibly in Arden Lea’s lab for me. A few days later, I received a telegram from Arden Lea offering me a postdoctoral position. That was unbelievable. It was a funny caveat to this: a few “knowledgeable” immigrants advised me to buy a suit. I did exactly that and appeared on my first day of work at the university in a light beige Italian suit.

Arden Lea was a mosquito specialist, right?

That’s right. Arden was an extremely fine mosquito physiologist. He could perform micromanipulation on mosquitoes, such as removal of the corpora allata, a tiny juvenile-hormone-producing gland, or reimplantation of neurosecretory cells. He also was a very good person and helped me a lot. My mosquito career started in his laboratory.



ADVICE

FROM A LEGEND

What do you look for in a potential postdoc or graduate student?

Of course, I look for excellence. Realistically, however, people are different in their skills and experiences. My goal is to recognize and bring the best in each person I work with.

Would you have any advice for international students? Is there anything that they should focus on in preparation for coming to the States to study?

In my experience, most international students are well prepared for a graduate school. My advice is to gain more knowledge of English.

What is your approach to mentoring?

One of the most rewarding sides of my work as a professor is helping my students and postdocs in their development. I work with my people very closely. I meet once a week with each member of the lab individually. Some people can work independently from the very beginning; others need more direction in their experiments. They tend to deviate and add unnecessary experiments to a project, and my goal is to show them how to stay focused. I have always had two postdocs to one student ratio in my lab. I believe that this provides an ideal environment for learning, developing experimental skills and analytical thinking—so necessary to become a mature researcher. It is particularly advantageous for graduate students.

Do you offer any final advice when a student graduates from your lab?

I say, “You have accomplished a lot during the five years of your training, and I am proud of you. Now, you are ready to conquer new scientific heights. Never stop learning and challenging yourself. That is the only way to becoming a successful scientist. Good luck!”



* Never stop learning and challenging yourself. That is the only way to becoming a successful scientist. Good luck!

How long were you at the University of Georgia?

Six and a half years. It was important time for adaptation to American life, for learning new approaches to science. On a personal side, it was happy time because our second son, Andrew Vincent, was born. Working with ticks back in Russia, I came to appreciate the dramatic changes in cells and tissues that occur under the control of a blood meal. My inspiration came from the work of Michael Locke, a remarkable insect cell biologist and electron microscopist, who observed fine structural details during insect metamorphosis. This experience helped me to initiate my mosquito work. I described the cellular modifications in ovaries and the metabolic tissue, the fat body, during the mosquito reproductive cycle. Next, I produced the monoclonal antibodies against mosquito vitellogenin, the major yolk protein in insects, and use this molecular reagent to trace the process of cellular secretion and internalization of vitellogenin in the developing oocytes. This was a very fine study. I wrote a grant proposal. The first part included a study of the biosynthesis of yolk proteins, and another [part] their internalization in developing oocytes. The NIH panel returned the grant and said, "It's too big and ambitious." I thought and thought on what to do, and I divided the big proposal in half. I submitted each part as an independent proposal. Amazingly, I was awarded both! At Georgia, I was promoted to the rank of associate professor without tenure.

The initial grant was resubmitted as two smaller grants, and still you were awarded the same dollars?

Yes. NIH funded both grants!

Then you were offered a tenure-track position at Michigan State University.

Yes. Entomology at Michigan State was impressed with my work: two NIH grants and publications. They offered me an associate professor position right away.

Do you remember your salary?

My salary was modest for an associate professor—\$35,000 a year.

That's a few more than 175 rubles a month.

Of course. As it happened, soon I was offered a position at Harvard School of Public Health. Michigan State made a

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“IN ADDITION TO A GREAT FEELING OF BECOMING CITIZENS OF THIS GREAT COUNTRY, WE FELT RELIEVED BECAUSE ALL THAT TIME AFTER LEAVING THE SOVIET UNION, WE WERE STATELESS.”

counteroffer, doubling my salary and promoting me to a full professor. [Laughs.]

Now that's called the American Dream.

Exactly. Meanwhile, I got another NIH grant to study mosquito immunity. With three NIH grants, my total annual budget was almost one million dollars. I had a big lab, and together we have accomplished a lot of significant studies.

Let me back up a few years. I assume you became a naturalized citizen. Describe the process. Was that easy for you?

Upon the arrival to the U.S., we were granted the refugee status. A year later, we received the permanent resident status—the so-called green card. And, in five years, we became U.S. citizens. In addition to a great feeling of becoming citizens of this

great country, we felt relieved because all that time after leaving the Soviet Union, we were stateless.

You had to pass a few requirements. You had to learn the Pledge of Allegiance and pass the English test.

Right. The examiner tested me on the knowledge of the Constitution and U.S. government, and then asked me to write "I want to become an American citizen." That was it! [Laughs.]

At Michigan State, you became a distinguished faculty member, and then you left.

It looks like a life pattern for me. The University of California–Riverside Entomology Department was famous at that time, with faculty whose research covered both basic and applied sides of insect science. Prior to our move to UC–R, my wife and I were on sabbatical in Australia, and I went to give seminars to several places, including CSIRO at Canberra, where Peter Atkinson worked; Bruce Hammock was there on sabbatical, and Lynn Riddiford and Jim Truman were visiting the place.

Wow, those are some very talented people.

I think that they were impressed with my presentation. After Peter moved to the UC–R Department of Entomology, I was invited for a seminar. I remember sitting with him after the seminar for lunch in a very beautiful courtyard with blooming orange trees. It was the beginning of March, and there was freezing rain back in Michigan. Peter said, "Would you like to relocate?" Well, the rest is history. I have been at UC–R for 20 very productive years.

You and your wife are elected members of the National Academy of Sciences. That's probably very rare.

Right. Especially among immigrants. To be elected to the Academy is a tremendous honor. Tremendous.

To your neighbor next door, how would you briefly explain the purpose of your research?

I would stress first the importance of mosquitoes as vectors of devastating human diseases. It is always striking to remind people that a child dies of malaria in Africa every 5–6 minutes. Mosquitoes require human blood for their egg development, and consequently they transmit

pathogens of dangerous diseases. Thus, it is essential to understand the link between blood feeding, reproduction, and pathogen transmission in mosquitoes. We are investigating these processes at the biochemical, molecular, and genomic levels, providing the basis for developing novel approaches of mosquito control.

Let me ask you a political question: what do you think about the Russian invasion of Ukraine?

As a former citizen, I'm horrified and ashamed. It's terrible, of course. I left the Soviet Union for many reasons, including because I didn't approve the political system. However, I thought that the country has changed for the better since then.

Do you think Russia has changed?

Regrettably not. It was a horrible, brutal country in the past and is horrible at present.

You faced discrimination in the Soviet Union because of your Jewish heritage. Have you faced discrimination in the United States?

Absolutely not. Neither at universities where I worked, nor outside in everyday life.

When are you going to retire and hang it up?

I'm applying for two large five-year NIH grants now. One is about the chromatin dynamics during the mosquito reproductive cycle, and another is on utilizing the CRISPR gene modification approach for investigating mosquito insulins. I am very excited to initiate these studies that will open the new phase in my research program. If awarded, I plan to work for these five years. Living for science is amazing, and I am grateful for having such an opportunity in life.

If you get those grants, that will take you to 80.

Exactly, and I will do this!

Acknowledgments

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Marlin E. Rice is a past president, Fellow, and Honorary Member of the Entomological Society of America.

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