

ACOUSTICS CONFERENCE *in* MOSCOW

By Robert T. Beyer

IN the spring of this year, a number of American acousticians, the author included, received invitations from the Planning Commission of the Fourth All-Union Conference on Acoustics to attend a May meeting in Moscow and deliver a paper on an appropriate topic. The opportunity of seeing Soviet science at first hand was too good to be missed, and, having made all the usual arrangements, I left New York on May 23, flying via Copenhagen and Stockholm.

Our group snowballed as we approached Moscow. Theodore Litovitz of the Catholic University of America joined me in Copenhagen, and when we boarded the Soviet IL-14 at Stockholm, we found Richard Bolt and Uno Ingard of MIT waiting for us in the cabin.

Our first Russian plane flight was very much as that described in a recent story in *The New York Times*. We were not permitted to have our cameras with us in the seats, the stewardess was most insistent that we take her candy as the plane prepared for take-off (when Professor Litovitz declined, she seemed prepared to employ force feeding), and after two hours of flying we landed at Riga for a visa check and dinner.

The stop at Riga recalled the stories of early rail-roading in the West, with everybody out for dinner at the Harvey House. The procedure was simple. We filled out a customs' form, gave the agents our passports, and were treated to a dinner in the airport restaurant. After the meal our passports were returned. We all posed by the side of our plane for each other's cameras and then flew on to Moscow.

We arrived at our destination at about 9:30 P.M., just as the Moscow twilight was gathering. Waiting to greet us at the front rail of the terminal were Academician N. N. Andreev, Corresponding Member of

the Academy L. M. Brekhovskikh, and several other scientists. Most of the group were those who had attended the ICA Congress in Boston in 1956. There was some confusion in finding our baggage (new construction work was in progress at the air terminal, as at almost every place else in Moscow). While waiting, we encountered the rest of our group, Arthur Iberall of Rand Development Company, Cleveland, Ohio, and Cyril Harris of Columbia University. They had flown in together from Prague.

Once the baggage had been found, we were driven, in several Zims, to the Hotel Metropole, where a night clerk assigned us our rooms, and where the reception delegation bade us a temporary farewell.

The hotel rooms were all large and old-fashioned, but clean and neat, and quite satisfactory. After settling our luggage, we reassembled in the hotel dining room for dinner at 11:00 P.M. This was the first of many irregular dinner hours, and we are still not certain as to what is the usual hour for a Russian to have his final meal of the day.

As a small token of the occasion, the hotel had placed small American and Soviet flags on our table. After the meal, a young man in rather rough clothes came to us from a nearby table. "I want to welcome you to Moscow," he said, speaking in very broken English. When pressed, he sat with us, and added these comments: "I am only a simple worker and do not know much English. In the newspapers I read only bad things about America. I want to hear the truth." And so, in a mixture of English and Russian, we talked about America.

Our routine on Monday set the standard for the rest of the meeting. Shortly after breakfast (a rather hilarious meal, with no menu, almost no English from the waitress, and no Russian food vocabulary from us), we were met by Igor Mikhaitsev and Iurii Lysanov, two younger research workers at the Acoustics Insti-

Robert T. Beyer is associate professor of physics at Brown University, Providence, R. I. During the period 1955-57 Dr. Beyer was editor of the AIP's translated journal, *Soviet Physics—JETP*, and he now heads the Institute's advisory board on Russian translations.



V. Krasilnikov, Moscow State University, who visited America in 1953 and 1957.



The Physics Building at Moscow State University, where all sessions of the conference on acoustics were held.



S. N. Rzhnevkin, senior professor in acoustics, Moscow State University.

tute. They both had a good knowledge of English and served as our guides throughout our entire visit. Lysanov was a member of the delegation which came to the ICA meeting in Cambridge, Massachusetts, two years ago. At that time he could speak no English, but he had certainly improved enormously since that time.

Since there was no session of the conference in the morning, our guides gave us a short sightseeing tour. We visited Red Square, circled the Kremlin (in a pair of chauffeured cars furnished by Intourist), and drove in and about many of Moscow's streets. First impressions were the great width of the main roads—sometimes eight lanes or more—the large number of people on the streets and the comparatively large number of motor vehicles. Upon later reflection I realized that many of these vehicles were busses, trucks, and taxis, and I gather that most of the remainder were official or semiofficial cars (like our own). Nevertheless, there was more traffic than I expected.

Perhaps the most tremendous sight is the building program. We were told that 400 new apartment houses are being constructed, each of 250 units and designed for 1000 people. We can well believe this. In the vicinity of the University, there must have been 100 or more, all very nearly identical. Almost everything that is new in Moscow is an apartment house. The "new building" of the University, as well as the just-opened Ukraine Hotel are almost entirely devoted to apartments. Otherwise, most public buildings date from before the Revolution (Russian, that is).

While on this tour, we came near the American Embassy, and so stopped to make ourselves known. We were treated very handsomely and had a twenty-minute meeting with Ambassador Llewellyn Thompson.

AFTER lunch at our hotel, we went to the University. These new buildings, as they are called, were opened in 1953. (The old buildings are located

near the center of town and all still used for university purposes.) They are devoted solely to science students, and there are 13 000 students in attendance. Many of these live in the great 787-ft main structure (which reminds one of the Wrigley building in Chicago). The sessions of the conference were all held in the Physics Building which is located behind the main building. There were three lecture rooms used for sessions. Registration for the meeting took place in a wide hall outside the central lecture hall. It is interesting to compare this meeting with those of the Acoustical or Physical Societies in America. The same crush existed at the registration desk, but there was no registration fee. Each delegate was given a badge (with his name typed in Russian) and a list of titles and authors of all papers. Later in the conference we received Russian abstracts of all papers.

Each of us had a number on our badge and a small pigeonhole for messages. These looked like an imitation of those set up at the Cambridge ICA meeting; only once did I see a message slipped into any of the boxes.

At a Russian meeting, the delegates gather in small clusters and talk about their problems and, just as in our own meetings in America, someone is always missing when you have decided to go some place in a group.

For refreshments there was a small soft drink counter—two kinds of drinks, both rather sweet and fruit-flavored. There was no exhibit of apparatus, nor were there any personnel men seeking to hire physicists for their companies.

At the first session, a Russian sat next to each of us Americans and kept up a whispered translation of the talk. As the conference progressed, however, we were left more or less to find our own interpreter. If any of us wanted one, there were always several available—good scientists and good translators.

The opening session was one of a group of plenary sessions, and had an attendance of 250–300. N. N. An-



At the meeting. Left to right, Academician N. N. Andreev, Mr. Iberall, Prof. Ingard, an unidentified person, Dr. Ying, Mr. Naugolnykh.

dreev delivered some opening remarks and was followed by L. M. Brekhovskikh, who spoke on surface-wave problems. V. A. Krasilnikov of Moscow State University then gave a paper on some problems in aerothermoacoustics. This was accompanied by several interesting demonstrations. The remaining paper at this session was written by Dah You Maa of the Chinese National University at Peking, but was read by another Chinese (in Russian) since Professor Maa did not attend the conference. Professor Maa was once a student in America, and is well known to many American acousticians, being a fellow of the Acoustical Society of America.

There were perhaps 300 persons attending the conference. In addition to the six Americans, this number included Per Brüel from Denmark, Erwin Meyer from Göttingen, several East Germans, and perhaps a half dozen each from Poland and China. One of the Chinese delegates, Chung-Fu Ying, was personally known to the author. Doctor Ying received his PhD from the Physics Department at Brown in 1952, and was a member of the faculty at Brown for two or three years after that date.

One of the outstanding features of this meeting was the amount of discussion that took place. The papers were all twenty minutes in length, and some discussions of individual papers lasted as long as one hour and one half, and were extremely vigorous.

The author was the first of the American delegation to read his paper. Since I had some knowledge of Russian, I thought it a polite gesture to give my paper in that language. I had written it in my brand of Russian, which Professor Krasilnikov was kind enough to edit. I was saved from further pitfalls by two graduate students, K. A. Naugolnykh and V. A. Burov, who supplied accent marks for all polysyllabic words in the paper.

I took advantage of the fact that I was the first American to speak, and delivered the greetings of the delegation, as well as those of the American Institute of Physics and the Acoustical Society of America, be-

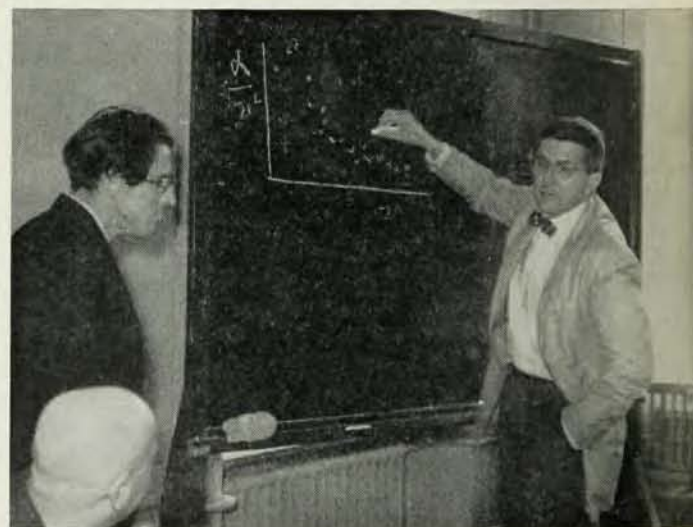
fore I gave my paper, which was entitled "Multiple Excitation of Energy Levels in Ultrasonic Absorption Processes".

In general, the Russians do not applaud after a paper. Out of courtesy, however, there was vigorous applause for foreign papers.

As an example of minor controversy, the following episode is worthy of mention. Immediately following my paper, I. G. Mikhailov of Leningrad State University read a paper on the absorption of ultrasonic waves in ethyl acetate. There is a group at the Moscow Regional Pedagogical Institute, led by V. F. Nozdrev and B. B. Kudriavtsev, who claim to have observed two peaks in the plot of absorption coefficient per wavelength against the ultrasonic frequency. This is contrary to recent measurements in England and America, wherein only a single peak is reported. Professor Mikhailov is a strong supporter of the single-peak school. I was somewhat in the middle. In my first research publication in 1946, I obtained measurements at lower frequencies which suggested the double peak, but I have long since concluded that these low-frequency measurements were in error, and published a recent note to that effect. As a result, both Mikhailov and Nozdrev could (and did) appeal to Beyer as a support for his side of the controversy.

This argument lasted for about an hour, and the comments became very sharp and almost bitter. It was resumed on the following day when Professor Kudriavtsev gave a paper in support of the two-peak theory. Nor was this the end. The Pedagogical Institute gave a seminar on Saturday afternoon (May 31) with four papers devoted entirely to the same topic. The vigor and enthusiasm of this group reached a climax at a banquet at this same Institute, where toasts were drunk "to two peaks".

Despite the acrimony of much of this discussion, the two groups appeared to maintain cordial personal rela-



Author makes comments on paper by Docent N. I. Koshkin at Pedagogical Institute. Head at lower left is that of Prof. Kudriavtsev. (Photograph supplied by Prof. V. F. Nozdrev.)

tions, for which I was greatly relieved. The point is not a great one, to be sure, and I believe that Nozdrev's group is off on a false path, but it was disconcerting to play the role of a stranger in the midst of a family quarrel.

ON Wednesday, we had a guided tour of the Acoustics Institute. This is a new building, perhaps a mile or so northeast of the University. It is, as we knew, under the directorship of Brekhovskikh, with sections in charge of M. A. Isakovich, V. S. Grigorev, L. D. Rozenberg, A. V. Rimskii-Korsakov (a close relative of the great composer), and Ia. M. Sukharevskii (who was not present). The building is four stories high and apparently possesses between 100 and 150 research rooms, which must make it about the world's largest acoustical research laboratory.

Only a few other visitors were in our company when we made the visit. We were first taken to the director's office, where the chief scientists were gathered and where a table was spread with fruit, candy and cookies, and Russian coffee, which is served hot, with lemon and sugar. I was surprised to find it quite tasty (I'm a cream-and-no-sugar man generally).

After the brief refreshment, Brekhovskikh gave a résumé of the laboratory's history and then called for questions. Chief questions centered about the size of the Institute and its relations with Moscow State University. It appears that Brekhovskikh holds rank, or simulated rank, as a Professor at the University, while Professor Krasilnikov also has a research group at the Institute. We were surprised at the relatively small number of graduate students at the Institute, but perhaps we did not get a clear mutual understanding of terms. Certainly, a hundred or more research rooms requires a large number of scientific workers, whether they be graduate students or not.

Over all, the laboratory had an ample supply of good electronic equipment and some first-class machine work. Most of the equipment was Russian, with perhaps 20% of (East) German manufacture, and a very small number of British and American instruments. Following the long-time interest of Andreev, the dominant field of interest of the Institute appeared to be high-amplitude and nonlinear acoustics.

We inspected some thirty research projects. There is a great deal of study on barium titanate transducers, some in Rozenberg's group and some in Grigorev's. They have made hydrophones with a diameter as small as 0.1 mm, which is a considerable achievement. At the same time, there has been widespread experimentation with curved barium titanate concentrators of the sound. I asked Rozenberg whether the reason for the great emphasis on concentrators of ultrasound in Soviet research was economic, and he agreed that this was the case (it makes possible the use of smaller amplifiers, etc.). These concentrators are widely used in industrial applications, such as degreasing and other cleaning operations.

Two years ago, Brekhovskikh wrote an article in

Pravda complaining of the small amount of development of barium titanate in the Soviet Union. Upon my asking, he said that they now had plenty, but of course would like more. Certainly they had an impressive array of hydrophones of all sizes, large and small. The pride they take in this work can be estimated by the fact that at the exhibit building of the Academy of Sciences at the (permanent) Agricultural and Industrial Exhibition, where models of the three Sputniks take up about one third of the exhibit space, perhaps one quarter of the total space is given over to a display of acoustic transducers. (The rest of the exhibit was devoted to electronic equipment and to publications of the Academy.)

Work is carried out on the visualization of ultrasound by exposure of ordinary photo paper. In an application of high-energy sound, studies have been made of the destructive action of cavitation bubbles on glass surfaces, employing high-speed photographic techniques.

Another interesting study was that of the magnetostrictive properties of ferrites. This is a comparatively new field of transducer research.

In finite amplitude studies, mention can be made of the fact that work is done at intensities (in liquids) as high as 300 watts/cm². At low intensities, the streaming effects are being studied in some simply but well-designed experiments.

As a separate project, a group working with N. A. Roi is experimenting with electrical spark underwater-sound generators. The efficiency of this technique is rather high, and the work is apparently highly esteemed. This work was reported on at the conference, but I did not hear the paper.

ON Friday (Memorial Day), there were three events of high interest. While riding in our In-tourist car (without guide) we saw a possibility for some good photographs of the Kremlin from across the Moscow River, and asked the driver to stop the car. He did so, directly in front of a ten-year school. While we were taking a picture, the students came out from their morning classes (or rather, examinations). The girls were mostly in uniform, the boys were not. We took their pictures and talked with them for perhaps an hour before any teacher came out. They came mainly from the sixth grade, being 13-14 years of age. They could all speak a little English, and sang a song in English to us. They were full of questions about us and America, including one from a boy, "What do you think of John Foster Dulles?"

I exhibited pictures of my family and house and the children were delighted when I gave a picture of my seven-year old daughter to one of the girls, she was so pleased that she kissed the picture again and again. This same girl told me that her father was also a physicist. He turned out to be I. M. Khalatnikov, the very well-known low-temperature theoretician at the Institute for Physical Problems!

On this same day, I visited Academician Kapitzka at the Institute for Physical Problems. This was perhaps



Students at the ten-year school. Third girl from left is Lena Khalatnikov.

the high point of the trip for me. As Crawford Dunlap has recently described a meeting with Kapitza in *Physics Today*, I shall not attempt to retell a very similar story, except for a few special points. I have had several years of correspondence with Kapitza since I was the editor of *Soviet Physics—JETP*, which is a translation of the *Journal of Experimental and Theoretical Physics* of the USSR, which Kapitza edits. To all the personnel of his Institute, he introduced me as his "editorial colleague". I rejoined that I was merely in charge of the New York office of his journal.

I should also note that I met Dr. Khalatnikov, whose daughter had already telephoned him about our meeting.

Academician Kapitza and I discussed various publication problems. He remarked that his journal was the only physics journal in the Soviet Union that was not limited in the number of pages it could publish each month.

In speaking of American journals, Kapitza noted that the academicians were each given copies of *The Physical Review* as soon as it arrives (the Academy purchases fifty copies), but that other scientists had to wait until it was photoreproduced. During my stay in Moscow, I saw photocopies of *The Physical Review*, the *Journal of Applied Physics*, and the *Journal of the Acoustical Society of America*, but was not able to obtain a copy as a souvenir.

One cannot come away from Kapitza without a quotation. He asked me if I had been impressed by what they showed me at the Acoustics Institute. When I said yes, he observed, "If you were impressed by what they showed you, think how much more impressed you would be by what they didn't show you!" The reader can supply his own interpretation to this remark.

At six o'clock that evening, we Americans attended, on invitation, a thesis defense of a student (*aspirant*) seeking to obtain a candidate's degree (*kandidat nauk*). The student was Mr. L. K. Zarembo, who works for Professor V. A. Krasilnikov at Moscow State Univer-

sity. The research, on the absorption of finite-amplitude sound waves in liquids, was of immediate personal interest to me, so that I was very glad to be present.

In many respects, the program resembled an American doctoral thesis defense, with the added fillip that the two readers of the thesis (called the first and second opponents) are each called upon formally to voice their criticisms of the thesis. They take the floor and criticize vigorously. The student then has a rebuttal, and the floor is open to other comments. At the request of Professor Krasilnikov, I made a few remarks from the floor. Shortly thereafter, the program closed and the examining faculty voted. Later Mr. Zarembo was informed that the faculty had voted—15 to 1—to accept the thesis. He observed to a friend, "All my life long, I shall wonder who it was who voted against me."

To top off this day, the successful candidate sponsored a banquet in a private dining room at the *Praga* restaurant (which is one of the best in Moscow). The fourteen guests included five members of the American group.

This was our first banquet, and set the pattern for four others that followed. The table was loaded with what one might call Russian smörgasbord, Armenian wines, cognac, and stolichnaia vodka. At an earlier time, we asked some one what the best brand of vodka was; "stolichnaia!" was the reply. (This means "capital".) Whether there was any other brand, I do not know; capital vodka was the only brand I ever saw.

SATURDAY might have been a day of relaxation, since only the single morning session was scheduled at the University. However, in the afternoon, V. F. Nozdrev of the Pedagogical Institute held the seminar on ultrasonic relaxations in ethyl acetate to which I made reference earlier. In the course of the afternoon, Professor Litovitz and I were shown the research facilities in ultrasonics at the Institute. While the research space and equipment were far less impressive than at the University or the Acoustics Institute, it is worth emphasizing that this was a teachers' college, which exists for the purpose of training teachers for the ten-year schools. What a novelty a research program in



Typical Russian (indoor) landscape.

physics would be at a state teachers' college in America!

We were somewhat embarrassed by a banquet at 5 P.M. at the Institute, for we of the American delegation had scheduled a banquet of our own for the leading Soviet acousticians and their wives at 9 P.M. the same evening. Toasts came thick and fast that day!

One member of our group "had a friend in Minsk who had a friend in Pinsk" who could arrange things. As a result, our banquet took place at one side of the grand ballroom of the newly opened Ukraine Hotel. We entertained about twenty of the scientists and perhaps five to ten wives or daughters. Most of the wives had already gone to country *dachas*, and could not come into town.

From this account the reader may judge that while the first part of this meeting was strictly science, the last half became more and more a gala social festival. He would be largely correct!

Sunday was devoted to an all-day excursion on the Moscow-Volga canal aboard the river steamer "Maxim Gorky". "As is well known," to cite a standard Russian gambit, "almost everything in the Soviet Union is named after a half dozen people". While in passage, we passed the "Karl Marx" and the "Joseph Stalin". There was a banquet, of course, during the afternoon of our voyage.

Monday brought back a full day of papers to be given or heard. These continued to reflect the primary Soviet interest in the nonlinear effects of finite amplitude sound. Late in the afternoon, we and several Czechs, including Professor Slavik, were driven to the summer home of L. M. Brekhovskikh for the evening. His *dacha* is still in process of construction. At the moment, it had no electricity (or house water; we washed in the yard), but it is expected shortly. At any rate, it was of no inconvenience to us. The meal was eaten on a spacious open porch, and since there was still good twilight at 10 P.M., we had no lighting difficulties whatsoever, and had a splendid time. We met Mrs. Brekhovskikh and two of their children. Their oldest daughter had gone to summer camp or farm.

Tuesday was the last day of the meeting. I think we were all rather sorry to come to the end of this visit among such a friendly group of colleagues. There is no doubt in my mind that stays of this length, or even longer, can help both sides of the world to understand each other better, as well as stimulate profitable scientific discussions.

On this last day, a number of small gifts were exchanged, and of course the market in reprints was flooded. I must have collected a total of fifty during the meeting, including translations of some of my own research articles, and the latest copy of the Soviet *Acoustics Journal*, in which I had published a short letter. Russians do not want to fall behind on the exchange of gifts. When Professor Litovitz and I gave two girl graduate students our (free) tickets to a performance of the Soviet equivalent of *Cinerama*, they

Academician N. N. Andreev addressing excursion guests aboard the "Maxim Gorky".



disappeared and returned a few minutes later with some Russian children's stories for Professor Litovitz and a splendidly illustrated novel by Gorky for me.

I hesitate to mention one more dinner party, but on the last night we invited eight graduate students to dinner (four boys, four girls). This made a very friendly and relaxed group, and we discussed many things, from Coca Cola to graduate study. One of the girls asked me about Brown.

"How many students?"

"3500."

"How many study science?"

"About 700." (I guessed at this figure; later I learned that the total was closer to 1500.)

"What do the rest do?"

That was a good question. What *do* the rest of them do? About half engage in serious study of the humanities and the social studies. The rest, I am afraid, just go to college (as, indeed, do some of the science students). Neither her English nor my Russian was capable of conveying this information adequately.

I was scheduled to leave Moscow on the famous Soviet jet liner TU-104 to Copenhagen at a very early hour Wednesday morning, June 4. I was at the airport at Vnukovo at 6:00 A.M., but the plane was delayed until about 8:00. Shortly after I reached the airport, however, Professor Nozdrev appeared, accompanied by his interpreter, who had done interpreting for us at the Pedagogical Institute. She was an English teacher and spoke good, if rather formal, English. Nozdrev insisted on a small celebration in the airport dining room, and soon I, who had not yet had breakfast, was in the extraordinary position of drinking champagne and eating chocolates at seven o'clock in the morning.

After such a farewell, I boarded the plane with a final wave to my Russian hosts, impressed with scientific research in Moscow, but even more impressed with the kindness and friendliness that Soviet scientists can show to their American colleagues in spite of the actions of their government.