

OBITUARY

EDUARD GRIGORIEVICH SHUTOV

Boris M. Schein

Eduard Grigorievich Shutov [Šutov] was born on February 5, 1929 in the village of Bodya of the Udmurt Autonomous Republic. Udmurtia is a part of the Russian Federation, situated in the northeastern European part of Russia in the western foothills of the Ural Mountains. After public school, Shutov became a student at the Udmurt Pedagogical Institute in Izhevsk, capital of Udmurtia. Pedagogical institutes prepare teachers for public schools all over the USSR; their graduates leave with degrees approximately the equivalent of a Master's degree in the United States.

After graduating from the institute in 1953, Shutov taught mathematics at a public school in Glazov, a town in the northern part of Udmurtia. Simultaneously he was an assistant to the mathematics chair at the Glazov Pedagogical Institute. In 1954, he became a graduate student of Professor E.S. Lyapin at the Leningrad Pedagogical Institute, and finished graduate school in 1957. In 1958 he received his Candidate degree (the Soviet Candidate of Sciences degree roughly corresponds to a Ph.D. in the United States). After that, Shutov returned to Udmurtia, where he taught at the Izhevsk Pedagogical Institute until 1965. From 1962, Shutov held the mathematics chair at the Institute, having the rank of Docent -- similar to an Associate Professor in the United States.

In 1965 Shutov moved to the Taganrog Pedagogical Institute. Taganrog, near Rostov, is a city not far from the mouth of the Don River, on the shore of the Sea of

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Azov. It is the birthplace of Anton Chekov, famous Russian playwright and short story writer. Shutov held the algebra chair at the Taganrog Pedagogical Institute from 1965 on; he became a full Professor in 1976. He continued to work in Taganrog until his untimely death on November 29, 1981.

Shutov started his mathematics research under the guidance of Professor Lyapin. His first paper was published in 1958 in the Proceedings (Učenyje Zapiski) of the Leningrad Pedagogical Institute. At the end of the 1940's Lyapin, who had been working in abelian groups, switched to what he called "associative systems," i.e., to semigroups. During these years, the theory of semigroups was appearing as a new, well-defined, separate branch of abstract algebra. Brilliant works on semigroups had been published in Russia and elsewhere before that time; however, semigroups appeared as a separate part of abstract algebra only at the end of the 1940's. Lyapin at that time was about to finish his monograph "Semigroups," the first book dedicated entirely to semigroups. It was finished in 1959 and published in Russian in 1960; the AMS has published three English editions.

At that time, Leningrad was virtually the only place where anyone wrote Ph.D. theses on semigroups: A.M. Kaufman got his Ph.D. in 1949; N.N. Vorobyov, who worked under the guidance of both E.S. Lyapin and A.A. Markov, received his degree in 1952; I.S. Ponizovskii finished in 1953; A. Y. Aizenshtat and E.G. Shutov completed degrees in 1958, and K.A. Zaretskii finished in 1959. In other places the activity in semigroups was not as pronounced as it was in Leningrad. L.M. Gluskin got his degree in 1952 in Kharkov (under the guidance of Professor A.K. Suschkewitsch, who himself was a pioneer of semigroup theory); later he headed another major semigroup center in the USSR. In 1953, V.A. Oganessian got his degree at Moscow University (he published a few brilliant papers on semigroups, but died prematurely). In the same year, A.D. Kacman received his degree in Sverdlovsk. Kacman's supervisor, Professor P.G.

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Kontorovich, who headed the algebra chair at the Ural State University in Sverdlovsk, was a group theorist interested in subsemigroups of groups; therefore he fostered research both in group and semigroup theories, organizing one of the major semigroup centers in the USSR. After his death, this center was headed by one of his students, L.N. Shevrin, who finished his degree in 1961. Still another semigroup center in the USSR appeared in Saratov, where Professor V.V. Vagner had turned to algebra (and semigroups) in the early 1950's. During that decade, however, Vagner's students worked mostly on geometric problems; the first Ph.D. thesis in semigroups written under Vagner (by the present writer) was finished in 1960 and defended in 1962.

Thus Shutov began his research when the theory of semigroups in the Soviet Union (as elsewhere, especially in the United States, France, Japan, Czechoslovakia, Britain, and Hungary) was growing very rapidly, when almost every year new active researchers joined the field, when good-natured team spirit prevailed and lifelong friendships germinated. All his life he was connected with this fine center of semigroups research, organized and created by Lyapin in Leningrad.

The first (and much of the subsequent) research by Shutov was centered around various "potential properties" of elements in semigroups. The concept of a potential property was introduced by Lyapin. Suppose P is a property of elements of a semigroup S (or of pairs of elements of S , etc.). An element $s \in S$ is said to satisfy P potentially if s has property P in an extension of S (i.e., in a semigroup T which contains S as a subsemigroup). In his first papers Shutov found conditions for potential (one-sided) divisibility of elements of a semigroup, for potential conjugancy of elements, and for their potential invertibility. (See [1] - [4] in the bibliography following this obituary.)

His next cycle of works was on semigroups of transformations. Shutov belonged to the majority of Soviet

specialists in semigroups who believed that semigroups of transformations constituted the core of the whole semigroup theory, the main raison d'être of the theory. His first paper on semigroups of transformations [5] considered the semigroup of all almost identity transformations of a set (i.e., those transformations which shifted only finitely many elements) -- this and analogous semigroups were investigated by him in a series of subsequent publications (cf. [7] - [9], [11]). In these and other papers (e.g., in [12] and [13]) he found all congruences on various classes of transformation semigroups (in the latter two papers he considered semigroups of continuous functions).

From 1963, Shutov attacked another cycle of problems: those of semigroup embeddings. Actually, his research on potential properties had already been connected with embeddings of semigroups in other semigroups; so, in a sense, he simply continued his previous line of research. In fact, his research on embeddings of semigroups led him again to potential properties (in semigroups, including transformation semigroups, and rings) -- see [20], [22], and [24]. He obtained a variety of fine results on embeddability of arbitrary semigroups in semigroups with prescribed properties. A semigroup S is called divisible if the equation $x^n = s$ is solvable in S for every $s \in S$ and every $n \geq 1$. In [15] Shutov achieved a fine result: that every semigroup (every inverse semigroup, group, respectively) is embeddable in a congruence-free divisible semigroup (inverse semigroup, group). Moreover, any semigroup is embeddable in congruence-free semigroups with zero and without zero. If S is a left cancellative semigroup without idempotents, then it is embeddable in a congruence-free divisible, left-cancellative and left-simple semigroup without idempotents. To get these and other analogous results, Shutov used new ways of proof. Usually, he reduced the problems to problems on transformation semigroups, or he considered constructions similar to free extensions of given semigroups. This made it possible to

find a very simple proof of P.M. Cohn's result of 1958 on conditions of embeddability of semigroups without idempotents in semigroups with unilateral division (the latter semigroups could even be congruence-free) -- see [19]. A semigroup with idempotents is embeddable in a congruence-free right-simple semigroup if and only if the semigroup is embeddable in a group [19]. A cancellative semigroup without identity is embeddable in a congruence-free cancellative semigroup without identity; a cancellative semigroup with identity is embeddable in a cancellative congruence-free semigroup if and only if it is embeddable in a group [21]. These are just a few samples of his results. He also considered embeddings of ordered semigroups, divisibility in the semigroups of all isotone self-maps of ordered sets, and various other problems. His last--both published and unpublished--results were connected with embedding semigroups in groups. He approached this well-known problem from a new point of view.

I give a bibliography of Shutov's works at the end of this paper, omitting numerous abstracts of his talks at various conferences. This omission is a Western habit. In Russia, abstracts cleared by state censorship and published are normally included in an author's publications list. Because it is difficult to publish papers, abstracts may contain interesting new results never published by their authors in a detailed form.

Taganrog, after Shutov moved there, became a small algebraic center. Shutov's best students worked on their dissertations both under his guidance and in Leningrad, under Lyapin. Usually they returned to Taganrog, so now there are a few young and able semigroup researchers there. These people are the best tribute to Shutov--the teacher.

He was a remarkable man. I have never seen him agitated or emotional. He spoke slowly, and took time to make his judgments (which were usually quite sound). He radiated solidity, reliability, calmness. He never

caused his friends to worry over his personal problems, and it was only after his death that we learned of his long and serious illness.

From 1958 the algebraic life in the USSR centered around annual All-Union algebraic symposia (they were called colloquia in Russia). The idea for the symposia belonged to Alexandr Kurosh; he organized the first two. The third (in 1960) was organized by P.G. Kontorovich. That was when I first met Shutov. His talk there was subsequently published [10]. There were no special sessions on semigroups at the first symposia, but we "semigroupers" usually found time to gather together, to discuss possible ways to develop the theory, and to raise new problems. Shutov was always an active participant in these meetings. In 1965 Lyapin invited Vagner, Gluskin, Shutov, Shevrin and me to the Herzen (Gercen) Readings, the annual conference of his institute. All five of us lived in one three-bedroom apartment. It was there that I came up with my pet idea of the time. I was impressed by "The Scottish Book" of mathematics problems collected by Polish mathematicians in Lwow before World War II, and by "The New Scottish Book", which appeared in Wroclaw after the war. Therefore I suggested that we start writing down semigroup problems in a separate notebook. Shevrin immediately produced a notebook, where I wrote down the first five problems (mentioning the prizes--usually measured in steins--for their solution), and Shutov was among the very first to give his problems there. After the conference, the owner of the notebook took it to Sverdlovsk and published it in 1969 as "The Sverdlovsk Tetrad" (in a greatly extended form, and without mentioning the prizes). I can testify that Shutov's problems led to interesting research, and two of them (about semigroups without nontrivial endomorphisms, and semigroups in which there is an endomorphism corresponding to every congruence) are still far from being solved.

In 1966 the first All-Union conference on the theory of semigroups, organized by J.V. Hion (Tartu) and E. Gabo-

vich (Tartu, now Karlsruhe), took place in Estonia. For tactical reasons it was called "The Interuniversity Scientific Symposium on General Algebra." Shutov was one of the principal speakers there, delivering a few brilliant lectures on embeddings of semigroups [27]. He was also among the principal speakers of the second All-Union Symposium on the Theory of Semigroups in 1978 (the first symposium under this name took place in 1969).

It is difficult for me to imagine semigroup life in the USSR without Shutov. Whatever I recollect, there he is always -- calm, quiet, and helpful. He lived and worked among us, leaving to his family and friends the legacy of his students and his works. These have contributed greatly to our knowledge and to the development of his field -- theory of semigroups. Sit tibi terra levis!

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