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A word about Chunikhin[1]

L. A. Shemetkov

Dear colleages,

I had the honour to be a student and a post-graduate student of S. A. Chunikhin. In this hall the other students of Sergey Antonovich have gathered together, and among them the oldest is Sergey Avramovich Safonov. Our conference is organized by Francisk Scorina Gomel State University, by the Institute of Mathematics of the Academy of Science of Belarus and by Taras Shevchenko Lugansk Pedagogical University. The last is no coincidence and takes us back to 1905. In S. A. Chunikhin's personal record we read:

Born on September 21, 1905,

Nationality — Ukrainian,

Social origin — son of a doctor.

In 1922 Ukrainian Chunikhin became a student of Don (now Rostov) University. In two years he was transferred to Moscow University. There, in the academic year 1927/28 he became an active witness of a historical event: for the first time in the history of Moscow University a course of lectures on the theory of groups was read. O. Ju. Schmidt was the originator of the course. Why have I called that event historical? Because it was also the beginning of Moscow algebraic school. Before that there had been no research on algebra at Moscow State University at all. S. A. Chunikhin was among the students of that course who later became the students of Schmidt.

For our foreign participants Schmidt is the author of the well-known theorem on direct decompositions, the author of the work about "Schmidt's groups". But alongside with that Schmidt had many various duties: he was engaged in Arctic research, was the chief of an expedition to the North Pole. Besides, he was involved in other activities not connected with mathematics. In those conditions aggravated with a serious illness (tuberculosis) O. Ju. Schmidt tried to find time and strength for the theory of groups so loved by him. The first sessions of the well-known seminar of Schmidt took place in his apartment. Besides Chunikhin, A. A.Kulakov, V. K. Turkin, L. Ya. Okunev, S. E. Arshon, A. P. Ditsman and A. G. Kurosh were among its first participants.

In 1929 Chunikhin graduated from the University and became a post-graduate student of O. Ju. Schmidt. Moscow period (1929–1941) was the period of growth and formation for Chunikhin. In 1934 at the age of 29 he was given the rank of Professor. There is a reference in in which A. N. Kolmogorov recommended to give Chinikhin the rank of Professor and characterized him as "a strong and cultured mathematician". In two years Chunikhin became Doctor of Science. During 12 years of Moscow period Chunikhin published 16 papers. Two lines can be traced in his research of that period. The first one was studying simple finite groups by the method of monominal permutations (the transfer). One of his results is the following[2],[3].

If G is a finite non-abelian simple group of order $p^{\alpha}n$, p does not divide n and $(p - 1, n) = 1$, then the orders of elements of the center of a Sylow p-subgroup of G do not

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[2]S. Tchounikhin, Math. Ann., 1935, Bd 112, 95–97.

[3]С. А. Чунихин, ДАН СССР, 1938, т. 20, № 2–3, 97–100.

exceed $\sqrt{p^\alpha}$. If in these conditions a Sylow p-subgroup P of G is abelian then the number of elements of the fundamental basis of P having the same order is more than 1.

The other line was connected with the development of research methods of investigating non-simple finite groups. In the paper[4] of 1929 we find the first mentioning of the groups which are now called minimal non-$\mathfrak{F}$-groups. He paid attention that Schmidt groups (he called them groups of type S) and their generalizations could serve as a tool for subgroup structure research.

In the paper[5] of 1930 he formulated the theorem about non-simplicity of a finite group with three classes of elements whose orders are coprime in pairs. This work induced popular "Chunikhin's problem" about groups factorable by two centralizers, the problem occupying the minds of many scientists until it was finally solved by Professor Kazarin who takes part in our conference.

In the work[6] of 1938 Chunikhin independently of Ph. Hall proved the solubility of a finite group having Hall subgroups of any possible order.

In those early Chunikhin's works we can see the grains in which his famous "Π-properties" originated. In the work[7] of 1938 he defined a *pd*-group as a finite group whose order is divided by a prime p. At that time he focused his attention on one prime number p. There was a long way ahead to Π-properties.

The new stage in S. A. Cnunikhin's life began in the terrible 1941. He moved to Siberia, the city of Tomsk where on August 29, 1941 he became Head of the Mathematics Chair of Tomsk Institute of Railway Engineers. The Institute was paramilitary. In 1945 Chunikhin was given the rank of "Director-Colonel of Administrative Service". At the same time he was working at Tomsk University as the Head of the Chair of Algebra.

Tomsk period of 1941–1945 was the period of rise for Chunikhin. On the 27th of December, 1942 O. Ju. Schmidt presented for publishing an article[8] in which we can already find the definition of a *p*-decomposable finite group (i. e. a group in which a Sylow *p*-subgroup is a direct factor). In the work[9] of 1947 (also presented by Schmidt) Chunikhin clearly outlined the program of studying *p*-properties for the fixed prime number p. In that work for the first time he introduced the concept of *p*-soluble and *p*-supersoluble finite groups and proved that the commutator subgroup of a *p*-supersoluble finite group is *p*-nilpotent. In that work of 1947 he also posed a problem of generalization of Ph. Hall's D-theorem for soluble groups, but at that time he could not find the generalization. During the following three years he was developing the concept of Π-properties (where Π is a fixed set of primes), and in 1949 he published a big article "On Π-properties of finite groups" in "Mat. Sbornik".[10]

Why he chose the letter Π is a mistery. The letter Π first appeared in his work[11] of 1948 in which he introduced Π-selected groups (he called a finite group Π-selected if the order of each of its chief factors is divided by not more than one prime in Π).

The problem of extending Hall's D-theorem onto Π-soluble groups was solved

[4]С. А. Чунихин, Матем. сб., 1929, т. 36, № 2, 135–137.

[5]S. A. Tchounikhin, Compt. Rend. Acad. Sci. (Paris), 1930, v. 191, 397–399.

[6]С. А. Чунихин (Москва), О разрешимых группах, Известия НИИ математики и механики при Томском гос. ун-те им. В. В. Куйбышева, том 2, вып. 2, 1938, 220–221; there in German: S. Tchounikhine (Moskau), Über auflösbare Gruppen, S. 222–223.

[7]С. А. Чунихин, ДАН СССР, 1938, т. 18, № 1, 9-10.

[8]И. К. Чунихина, С. А. Чунихин, ДАН СССР, 1943, т. 39, № 2, 43–45.

[9]С. А. Чунихин, ДАН СССР, 1947, т. 55, № 6, 481–484.

[10]С. А. Чунихин, Матем. сб., 1949, т. 25(67), № 3, 321–346.

[11]ДАН СССР, 1948, т. 59, № 3, 443–445.

by Chunikhin in his work "On Sylow properties of finite groups"[12] (presented by O. Ju. Schmidt). Even if it were his only work it could make him famous. Now Chunikhin's theorem on Π-soluble groups is included into all modern textbooks on the theory of groups. According to S. A. Chunikhin a finite group is called Π-soluble if the order of each of its composition factors is either a prime in Π, or is a Π'-number. In Hall's terminology Chunikhin's theorem is formulated as follows:

Every finite Π-soluble group possesses properties D_Π and $D_{\Pi'}$.

The estimation of Chunikhin's activity during Tomsk period would be incomplete if we did not touch the conditions in which he worked. Of course, the war and post-war years were hard and lean. Besides, he endured personal tragedy: the illness and death of his wife. But the matter was not only in that. The Siberian city of Tomsk was very far from scientific centres. Scientific news simply did not reach it. There was no modern scientific literature. But the main difficulty was that Chunikhin was working in complete isolation, he had nobody to discuss his theorems and their proofs with. Besides, there were no external stimuli for scientific research. That's why the scientific rise of Chunikhin in that period was really heroic. For comparison: another known algebraist Professor F. Molin could not get a post of professor in the European part of Russia due to the reasons not connected with science and had to leave for Tomsk where his scientific career suddenly ceased for ever.

In 1950 Chunikhin married again. Tamara Krikorovna Shagliyants became his wife and devoted mate for the rest of his life. The opportunity to move closer to scientific centres appeared to Chunikhin in 1953 in connection with opening Belorussian Institute of Railway Engineers in Gomel. For Chunikhin Gomel period (1953–1985) was the longest, the most productive and the happiest. In Gomel he wrote two thirds of his papers including the monography "Subgroups of finite groups"(1964), which was later translated into English.[13]

In 1964 he founded the Department of Algebra and Geometry in Gomel Pedagogical Institute (now it is a university), founded the academic laboratory, and for a number of years he was the Head of Gomel Branch of the Institute of Mathematics of the Academy of Science. Twice, in 1968 and 1975, All-Union algebraic conferences took place in Gomel, and Chunikhin was chairman of organizing committees of both of them. In 1966 he was given a rank of Belarus academician.

It is necessary to say about Chunikhin's special attitude to conferences. In those years big algebraic conferences took place in various cities of the USSR. Chunikhin neither participated in them nor sent any abstracts.[14] Many algebraists started even to think that Chunikhin was a kind of Burbaki. He made an exception in 1967 when a regular algebraic conference took place in Riga. Chunikhin came to the confertence with a big group of his students and even presided over one of its plenary sessions.

In Gomel Chunikhin organized a scientific seminar just like the seminar of his teacher O. Ju. Schmidt. The seminar started to work in 1953, and in some years Chunikhin had a few actively working students. Chunikhin's students started to defend their candidate theses regularly in Minsk, Moscow, Sverdlovsk, Kiev.

The subjects of Chunikhin's scientific research during Gomel period were focused on two problems:

1) the problem of extending Ph. Hall's theorem about Sylow systems of finite soluble

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[12]С. А. Чунихин, ДАН СССР, 1950, т. 73, № 1, 29–32).

[13]S. A. Chunikhin, Subgroups of finite groups. Groningen: Wolters-Noordhoff, 1969.

[14]Chunikhin's survey «Some directions in the development of the theory of finite groups for last years» has been read by his student S. A. Safonov in September, 1960 at the All-Union colloquium on General Algebra in Sverdlovsk; this survey is published: Успехи мат. н., 1961, т. 16, вып. 4(100), 31–50.

groups onto arbitrary finite groups;

2) the problem of interrelation between the subgroup structure of a finite group and the subgroup structure of its chief factors.

He devoted a series of his works to the problems and obtained complete beautiful results. They received A. I. Maltsev's approval who wrote to Cnunikhin in one of his letters, "I read your works with big interests. Among the papers you have sent me the work «On factorization of finite groups» is especially remarkable by its simplicity and the grace of formulations. It seems to me it can become the beginning of the whole series of works concerning the problems posed by you". And it came true. Working out the problems led Chunikhin to the construction of the indexial theory. Chunikhin's approach arosed the interest of H. Wielandt who also started the research on the problem. The remarkable theorems of Chunikhin and Wielandt with full proofs were included into the two-volume monograph by M. Suzuki "Group Theory"(1986).

On the whole S.A.Chunikhin prepared in Gomel 25 Candidates of Science. Six of his Gomel students became Doctors of Science, Professors (Ya. G. Berkovich, L. A. Shemetkov, A. V. Romanovsky, E. M. Palchik, V. A. Vedernikov, S. A. Rusakov). Chunikhin's school goes on developing. His students have their own students.

Academician M. A. Lavrentiev once said, "There are no scientists without students."He meant that a true scientist must provide the preparation of scientific successors. S. A. Chunikhin completely satisfies the definition of a true scientist; his scientific results and his scientific school are for ever.

F. Scorina Gomel State University