A VIEW OF SOVIET TOPOLOGY

by

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Topologists in general are familiar with the names
Paul Samuelovich Urysohn, Paul Sergeevich Aleksandrov, and
Andre Nicholaevich Tikonov, and all mathematicians with
Nicholai Nicholaevich Luzin and Dmitrii Fedorovich Egorov.
Of all these, the first three were influenced in the
directions of their study by Luzin who in turn had been
influenced by Egorov. In addition the world of Soviet
mathematics, and topology in particular, owes much to the
father of one of these men.

Nicholai Nicholaevich Luzin (1883-1950) was the only
child of a business man of the same name in Irkutsh
(Siberia) who solely for the sake of his son left his
business between 1893-95 and moved his family 1000 miles
to Tomsk. In 1901, when his son had completed his secondary
education, the elder Luzin again transplanted his family,
this time to Moscow, a distance of 2000 miles. These two
moves were for a total of 3000 miles, a trip equivalent to
a journey across the United States. The first part of the
trip appears to have been equivalent in hardship to the
travels of our American pioneers, since rivers and wagons
were the only means of transportation in Siberia at that
time. The move to Moscow was probably easier because by

1896 the first branch of the trans-Siberian railroad had
reached the River Ob at Tomsk [N].

These moves were made for the benefit of the son's
education, the first to enable him to study in a good
secondary school. When it was discovered that Nicholas was
doing poorly in mathematics, a tutor (from the recently
established Tomsk Polytechnical Institute) was hired.
This person discovered that although Nicholas found it
difficult to reiterate mathematical proofs (a method of
teaching prevalent at the time) he could easily deduce his
own.

At the University of Moscow, Luzin enrolled in the
Faculty of Physics and Mathematics since he knew that a
good mathematics foundation was necessary in his desired
career of engineering. It was then that Dmitrii Fedorovich
Egorov (1869-1931) noted the mathematical promise in the
young man and took it upon himself to guide him into a
career in mathematics, which eventually would enable Luzin
to influence Aleksandrov and Urysohn. This doesn't mean
that Urysohn and Aleksandrov wouldn't have collaborated in
their "Memoires on compact topological spaces" which was
to direct Aleksandrov's life from then on if it hadn't been
for the influence of Luzin, although neither came to the
University because of him. (Sadly enough the story does
not have a happy ending for the well-meaning father as he
lost all his savings gambling on the Moscow Stock Exchange.)

Paul Sergeevich Aleksandrov (1896-   ), the son of a
rural country doctor, grew up in the small city of Noginsk

just to the east of Moscow and went to Moscow to study

mathematics because of the influence of his school teacher,

Aleksandr Romanovich Eyges. It was there that he came

under the influence of Luzin and ironically it was because

of Luzin that Aleksandrov almost left mathematics entirely.

After initial research success on the cardinal number of

Borel sets, Luzin presented him with the problem of the

continuum hypothesis. Frustrated by his inability to

solve the problem, Aleksandrov left Moscow to teach litera-

ture but returned in 1921 to take his Ph.D. examination.

    It was at this time that he met Paul Samuelovich

Urysohn (1898-1924) who had traveled 700 miles from his

home in Odessa to matriculate at the University. Origi-

nally he planned to study physics (and indeed his first

publication was in that field) but he too fell under the

spell of Luzin and turned to mathematics for his career,

and thus met Aleksandrov, setting the stage for their

remarkable memoir and the development of compactness and

its importance in the budding field of topology. However,

if the two of them hadn't collaborated it would have been

done by someone else, as the time was ripe. But the impor-

tant thing to realize in this story is that it was the

teachers and the desire for a good education that led to

the development of the mathematics school at the University

of Moscow.

    Today Soviet school children enter school at the age

of seven to start their ten year secondary school education.

As a contrast, in his autobiography [P], Lev Semnovich

Pontryagin (1908-   ) states that his education was nine
years of elementary school and 4 years of college (versus
the current five years), but despite the fact that he deemed
it more than adequate, the increase of knowledge has almost
demanded an increase in the length of education everywhere.
In the Soviet schools the first four years are termed
elementary, years 5-8 incomplete secondary, and years 9-10
complete secondary. The Soviet child attends school six
days a week from September 1 through May 30.[2]

During the elementary years, the school day is 24
hours a week, 30 hours during the next four years, and 32
during the last two. Under current Soviet policy, in those
republics in which Russian is not a native language, a
study of Russian is required in addition to the study of
the native language and this may necessitate an additional
year of schooling.

Most westerners have a view of the Soviet school child
being strictly disciplined in school, an opinion enhanced
by visions of youngsters attired in freshly ironed and
starched uniforms. In the author's experience nothing is
further from the truth. During the six months spent in
the Soviet Union, the three boys attended English Specialty
School 4 in Moscow. Although uniforms were worn by about
90% of the students, the only place discipline was observed
was in the apartment building. In school, bedlam seemed
to be the rule, especially during breaks. Many times
unruly students caused a teacher to cancel classes and

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[2]All statistics concerning the educational policies
of the USSR may be found in [RZO].

the students went outside to continue their routines.

Two meals are normally eaten in school: a second
breakfast of pastries and cocoa midmorning, and a complete
meal at noon.   (These meals cost about 45 cents a day.)
For working parents, the school serves as an afternoon
daycare center for the elementary portion of the school
with special classes being run until 5 p.m.

Studies are broken into three parts:

The Humanities (literature, Russian, native or foreign
language, history, social science, geography) comprise
about 40% of the studies or 45-47% where Russian is a
second language.

Natural Sciences including mathematics compose 35% of
the time; and the remainder is taken up with physical
training (2 hours per week) and labor shop training.

Also the older children receive some instruction in
military discipline as an extracurricular activity, com-
plete with sticks or carved wooden guns. This sense of
military importance was evidenced on Army-Navy Day (February
23) when the girls presented the boys with congratulatory
cards and badges and members of the various military branches
visited the schools.

The natural question to ask about the education is "Do
the Soviets really stress the natural sciences?" The
author's experience would give an affirmative answer. The
placement of the boys in the school was based solely upon
a mathematics test--age was not considered. The seventh
grader was placed in the fifth form (the students a year

younger than he) where he encountered algebra and biology.
In a report to the National Science Foundation, Professor
Izaak Wirszup of the University of Chicago, reports that
98% of the school age population "study mathematics through
the calculus. By the time they graduate from secondary
school, Soviet students have also completed 5 years of
physics, 4 years of chemistry, 5 1/2 years of biology, 5
years of geography, and 1 year of astronomy" [W].

        Upon successful completion of his secondary education
(which is culminated with mandatory examinations) a student
may enter a university with the only official entrance
requirement being a passing score on a secondary school
examination. There is no tuition. This as well as the
many universities which have been built throughout the
fifteen republics since the revolution, the Soviet educa-
tional system owes to the policies established by Vladimir
Illych Lenin, policies which undoubtedly are a result of
the difficult time which he had in acquiring his own educa-
tion. To illustrate the increase in educational institu-
tions, in 1914-15 there were 12 universities in Russia
with 41,000 students; in 1975 there were 69 universities
with more than 500,000 students.

        Moscow State University (referred to hereafter as MGY)
was in the time of Luzin's matriculation and is now the
most prestigious university in the Soviet Union and boasts
five nobel laureates on its faculty in addition to such
past scientific names as Pavlov, Chebyshev, Mendeleev and
Lobachevsky. Busts of these men are to be found in the

park on the Moscow River side of the university and it is

interesting to note that despite the Soviet penchance for

putting plaques up everywhere denoting where Lenin lived

or Puskin slept, for example, these are the only commemora-

tions for mathematicians which the author saw.

MGY has an enrollment of about 30,000 students whose

study in 260 departments are directed by a faculty of

7,000 (this figure included research workers, i.e., labora-

tory assistants). Included in this number are 106 members

of the Soviet Academy of Sciences, 950 doctors of science

and 3,500 candidates of science. Academic titles at a

university are assistant (assistant professor), docent

(associate professor), and professor.

Many of the faculty and students have been housed in the

main building on the campus since the early 1950's when

the university moved from downtown Moscow near the Kremlin

to Lenin Hills. Aleksandrov has had an apartment here as

well as the dacha in Komoarovka on the Klazma River out-

side Moscow which he and Andrei Nicholaevich Kolmogorov

(1903-   ) have shared since 1935.

A university education takes five years and includes

a thesis written during the last year--this makes the basic

college degree the equivalent of our master's degree. Up

to the age of 35, a student may pursue the degree of Candi-

date of Science which is the equivalent of our Ph.D. This

degree normally takes three years of study if the student

pursues it full time as an aspirant in an institute of the

Academy of Sciences or at the University, or 4-5 years if

the studies are undertaken while employed as a research
worker either in an institute or university. The degree
is awarded upon successful completion of exams, a foreign
language (which usually seems to be English) and a defense
of a dissertation. A dissertation defense includes a 20
minute presentation by the aspirant and then brief criti-
cism and/or support by two opponents. The dissertation (as
well as the senior thesis) must then be approved by the VAK
(Higher Attestation Committee), which is the central aca-
demic degree awarding authority established under the
Council of Ministers of the USSR.

The Doctor of Science--a degree for which there is no
equivalent in this country--is awarded to those candidates
who present an additional approved dissertation which opens
a new avenue in the corresponding branch of science. In
1916 Luzin was awarded his Doctor of Science in Pure Mathe-
matics based on his candidate's dissertation, the first
time such an award had been made in 60 years.

This degree may also be awarded based upon superior
teaching or research performance. Nina Karlovna Bari
(1901-1961) was awarded her Doctor of Physical-Mathematical
Sciences in 1935 without benefit of a dissertation, based
only upon her reknown as one of the world's specialists in
the theory of functions of a real variable. In both cir-
cumstances, approval by the VAK is required.

Other than having a position as a university profes-
sor, a graduate may also obtain a position in one of the
many research institutes of the Academy of Sciences. This

organization is similar to the United States National
Academy of Sciences in name only. The latter organization
(founded by an act of Congress) is purely honorary with no
influence or research institutes. On the other hand, the
Soviet Academy (founded in 1724 by Peter the Great) runs
250 research institutes employing 160,000 scientific
workers of whom 2,000 are Doctors of Science and 12,000
are candidates of science.[3] These workers need not be
members of the Academy. The institutes are similar in
nature to the Institute for Advanced Study at Princeton,
the Courant Institute in New York, and the Institute for
Medicine and Mathematics at Ohio University.

    The members of the Academy are in three categories:
academicians or full members of which there are 245 in
the Soviet Academy, corresponding members (447) and
foreign members (80). Election to membership is by secret
ballot of the full members of the Academy with a two-thirds
majority needed for election. Although the election is
ideologically based upon a person's scientific achieve-
ments, in fact it can be extremely political.

    In 1927 Nicholai Nicholaievich Luzin was elected a
corresponding member of the Academy. In 1929 he was pro-
posed for full membership and was assured of the support
of some of his students. However, during the election
process some of his students turned against him. The
results of the election were surprising: Luzin was
elected Academic, but in the Department of Philosophy

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[3]All statistics regarding the Soviet Academy of Sci-
ences are found in [K-VL].

and only later in mathematics. Among the other people

mentioned, P. S. Aleksandrov became a corresponding member

in 1929 and Academic in 1953; A. N. Kolmogorov became an

Academic in 1939; A. N. Tikonov was made a corresponding

member in 1939 and Academic in 1966; and L. S. Pontryagin

became a corresponding member in 1939 and an Academic in

1958.

The election to membership is more than honorary.

Among other things (which may include the use of Academy

automobiles) a corresponding member receives a monthly

bonus of 200 rubles (300 dollars), and an academic, a

monthly bonus of 500 rubles (750 dollars). This is on top

of the monthly salary earned at the person's other posi-

tion. Examples of monthly salaries at a top level insti-

tute are:

    junior scientific worker with an academic degree earns

        about 200 rubles;

    senior scientific worker with a candidate of science

        degree earns 300 rubles;

    and a senior scientific worker with a doctor of

        science degree and 10 years of experience earns

        400 rubles.

A professor at a university with a candidate of

science degree earns 400 rubles per month. There are

bonuses for contract research and teaching. An interesting

comparison the author observed were advertisements for

trolley drivers which had, among other benefits such as

day-care centers, a starting salary of 250 rubles/month.

Institutes of the Academy in Moscow have security guards at the entrances (in most cases just elderly men or women earning their pensions) and visitors must have a photograph accompanied by a written pass which is kept under glass at the security table. However in Leningrad at the mathematics institute and even at the presidium of the Academy in that city, there did not seem to be guards. The guard outside the building in which Academic Mikahil Alekseevich Lavrent'ev (1900-   ) has his Moscow office was a police officer; probably because Lavrent'ev is a member of the Presidium of the USSR Academy of Sciences as well as a member of the Supreme Soviet since 1958 (he was admitted to membership in the Communist Party in 1952).

The Steklov Institute for Mathematics in Moscow, an institute of the Academy, is headed by Ivan Matveevih Vinogradov (1891-   ).

Within the Steklov Institute are housed topical groups, each headed by an Academic, who is Aleksandrov in the case of the topological group in Moscow. Other members of the group and their areas of study are:

K. A. Setnikov, who, along with his current aspirant, studies geometrical questions of the homological theory of compactness;

M. A. Shitanko who is currently studying the embedding of compacta in manifolds;

M. M. Postnikov studies the basic theory of homotopy;

E. V. Shchepin is investigating the construction of spectral theory; and

A. A. Mal'tsev and his current aspirant study topo-

     logical algebra.

These people are appointed for a set period at the end
of which they are reviewed to determine if their accomplish-
ments merit another term. There seems to be no government
direction of research, that mathematicians--at least in the
Academy institutes--are as free to study what they want
as we are in this country, despite the fact that the Academy
is financially supported by the government.

Publication is encouraged by payment for papers and
foreigners who publish in Soviet journals must waive such
payment. Many of these people also supplement their
salaries by teaching in technical institutes.

The topology group is housed in two small offices
(each of them is about 100 square feet) which other than
almost daily use by Mal'tsev in his capacity as Aleksandrov's
secretary are usually occupied only on Thursdays (which are
traditionally library days). The group members do their
research at home. This is not typical of all institutes
as a friend of the author's worked at her institute 8-5,
five days a week.

The library seems to be fairly well equipped with
books and journals although the American journals arrive
several months after they do in the States. Almost all
foreign journals in the library seem to be acquired by
exchange with the publisher of the journals. The reason
for this is that the Soviet ruble is not an international
currency and thus payment for journals is difficult.

Another example of the difficulties encountered is some-
thing which is taken for granted in this country: xeroxing
of journal articles--the library in the Steklov Institute
did not have a xerox machine.

Also the library books have to stay in the institute
and may only be held overnight. The building in which the
institute is housed is owned by the computer institute.
Plans to construct a building for the Steklov Institute
had been pushed aside by the Olympics.

Current results and ideas are exchanged at a seminar
held weekly on Wednesday afternoons during the academic
year at MGY. This seminar has been in continuous operation
since it was founded by Urysohn in January of 1924. This
contradicts the date as stated by Aleksandrov in his auto-
biography [A]. There he states that the seminar was started
in the spring; but during a conversation with Aleksandrov
and the author, Andre Nicholaevich Tikonov (1906-   )
recalled that Urysohn started the seminar in January and
Aleksandrov joined it in the spring.

At that time, the seminar met in three groups:
the first group studied the topology of the continuum;
the second was of a teaching nature and studied sur-
    faces;
the third considered the abstract character of topo-
    logical spaces.
This was the section attended by Viktor Vladimirovich
Nemytskii (1900-1967) (who later married Nina Karlovna
Bari) and Tikonov. The world of mathematics is well aware

of the important, but brief, research of Tikonov in topology
which resulted from this seminar and in which the influences
of his first teacher are so evident.

The current seminar is of a nature different than any
other which the author has ever attended since conversation
between members is constant as are comments of criticism
and/or support (clarification) between lecturer and other
participants. Most of the talks are scheduled for 1 hour
(beginning at 4) except for the first and last sessions of
each semester which are for briefer announcements of
results. Paul Sergeevich sits near the front with his
eyes closed and his head down and in all appearances is
asleep--he does this because his vision and his hearing are
bad and he must concentrate to listen to the speaker.
Despite these handicaps he is the first with praise or
biting criticism. When Aleksandrov is not there, Yu. V.
Smirnov is usually in charge.

There is a question of what will happen to each of
these two groups, the seminar and the Steklov topology
groups, when Aleksandrov dies. He was 85 on May 7, 1981.
The seminar will go on, probably chaired by Smirnov, but
at the present time there is no Academic to head the Steklov
group.

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