THE 1965 HUMSAN SCHOOL IN ERGODIC THEORY

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This text represents a slightly edited version of a set of notes for the talk at the opening day of the rigidity conference at the Erwin Schroedinger Institute in Vienna in February 1997 organized by Gregory Margulis, Klaus Schmidt and myself. M. Ya. Antonovsky, the principal organizer of the event, was present and gave an interesting talk which unfortunately was not recorded. I owe some of the details to him but of course I am responsible for all errors.

The school in Ergodic Theory took place at Humsan (a mountain resort about a hundred miles north of Tashkent) in Uzbekistan in the second half of September (exact dates?) of 1965. It was organized by M.Ya.Antonovsky, then a professor and the head of Mathematics department at the Tashkent Polytechnic Institute, under the general sponsorship of T.A. Sarymsakov, the Minister of Education, of the Uzbek Soviet Socialist Republic and a respected mathematician.

The program covered a broader range of topics than what is customarily classified as ergodic theory: smooth dynamical systems, theory of group representations, mathematical physics, cellular automata probability and geometric topology were represented

The school lasted two weeks. Its formal part included series of lectures (Rokhlin-Sinai, Sinai-Anosov, Sarymsakov-Boltyansky-Antonovsky, Kirillov) and individual talks (the seminar was well attended and very lively). Among of the most important and fruitful features were extensive informal and semi–formal discussions of hot topics (e.g. entropy formula, approximations, new cases of isomorphism for Bernoulli shifts).

Three key groups of participants:

1. Leaders in the field at the time, mostly young: Sinai (who turned 30 during the school; this event was properly celebrated), Anosov (29), Arnold (28), Alexeyev (33), Vershik (32), Rokhlin, Fomin.

2. Highly accomplished mathematicians, mostly also young, whose main intersts and achievements were in other fields, but who often had strong interest in the area (Kirillov (29), D.Fuks (26), Minlos (34), Maslov (34), Ladyzhenskaya, Dobrushin (?), Pyatetski-Shapiro, and others whom I do not clearly remember now.

3. Very young mathematicians mostly undergraduates or beginning graduate students, some of whom later became leaders in the field, others made their mark in other areas of mathematics: I.Bernstein (20), B.Gurevich (27), A.Katok (21), D.Kazhdan (19), A.Kouchnirenko

(21), G.Margulis (19), M.Novodvorsky (19), V.Oseledets (26), A.Stepin (25), M.Yakobson (20).

Naturally, there were other participants, including a number of mathematicians from Uzbekistan, for whom the school was a great learning experience. Plykin and other students of Antonovsky played important role in the organization. In particular, Plykin participated in writing the major paper by Anosov and Sinai for the proceedings The total number of participants was about 90 (?). Peculiarly, there was not a single foreigner.

This was one of the series of four schools which took place at Humsan during the sixties. The other three were in topology (1963?), mathematical economics (1967?), and another subject which I do not quite remember now. All schools seem to have made major impact in their respective fields. (Maybe say something about the scientific and administrative set-up which made this possible; funds from big defence (?) establishments)

Physical set-up. It was extraordinary. Humsan is an isolated hamlet at the foothills of the Tyuan'-Shan' mountains at the altitude of about 1500 meters. Immediate surroundings are dry with few trees but higher in the mountains there are fir forests, streams and lakes. [1] The school took place in a rest house which belonged to "Uzbekbrlyashu", the union of consumer cooperative society of the Uzbek Soviet Socialist Republik. The buildings were rather spartan in appearance and amenities. There were cottages for more senior particiants and a bigger, hostel–style builbing for the rest. The grounds were covered with lush vegetation including old vines which at the time of the school were full of large ripe sweet grapes. Grapes of this kind were rare in the Soviet Union and grew mostly in the Central Asian republic. They were considered a great delicacy by people living in the Cenrtal Russia. Huge bowls of grapes were served to the participants and younger ones (e,g, Katok and Stepin) would sometimes help themselves by climbing to the old trees, surrounded by vines (as Stepin remembers) Probably, irrigation was needed to support this vegetation. There was a fast mountain stream flowing either through or very near the grounds.

[1] For aficionados of the "Great game", it was in and very near Humsan where the famous British agent Colonel Balley, "The last great player of the Great game", was hiding in 1918/19 after he fell out with the Bolsheviks and escaped from Tashkent. See F.M. Balley *Mission to Tashkent*,The Folio Society, London, 1999; especially the map facing p. ix and pp. 136 and 145.

Scientific organization of the school. Who decided on the topics and how? Lecture series by Rokhlin-Sinai (entropy) Anosov-Sinai (Hyperbolic systems) Sarymsakov-Boltyansky-Antonovski (topological semifields?) Kirillov (non–commutative ergodic theory).

Some talks: Alexeyev, Arnold, Katok, Stepin,Vershik, Kouchnirenko, Minlos.

Proceedins of the school were published in Uspehi Mat. Nauk, 1967, N5. (English version: *Russian Math. Surveys*, **22**, No.5 (1967). The volume included articles based on the courses (Rokhlin, Sinai-Anosov, Kirillov) and material based on the talks and later developments stimulated by the school (Katok-Stepin, Kouchnirenko, Margulis,Yuzvinsky). It is a landmark collection which influenced the development of the field for years to come. See *Ergodic theory from Humsan to Vienna* for a more detailed discussion.

Social activities at Humsan. Charades were played with great zest, dedication and skill. Jumping and swimming in the stream.The famous hike when Kazhdan took a group of people to the (unknown to him) mountain area and the group did not returned until very late at night, experienced dangerous adventures on its way back and cused a serious alarm at the school. Everything ended happily however when the group returned late at night. after hair-raising adventures. I was not sufficiently brave (or too prudent) to join the group and went during this day of rest on a more conventional mountain hike with Yakobson.