ARMAND BOREL IN HONG KONG

NGAIMING MOK*

In the summer of 1997, I called Professor Armand Borel while he was on vacation in Switzerland, and asked him if he could be interested to be a Distinguished Visiting Professor at our university, the University of Hong Kong (HKU), to lead activities on Lie groups as a program of an Institute of Mathematical Research (IMR) to be established. I managed to convince him that this was worth serious consideration despite his many commitments, and he accepted to pay a short visit to Hong Kong before going back to the United States.

In Hong Kong he met with our Vice-Chancellor Professor Patrick Y.C. Cheng, who was particularly eager on our plan. It remained for our Department Head Dr. K.Y. Chan and myself the daunting task to convince Professor Borel to commit himself. It must be understood that research as a general practice across tertiary institutions in Hong Kong was at that point a relatively new undertaking, and on the subject of Lie groups we had really little to offer. As for myself I tried to convince him that Hong Kong was at a cross-roads, a historical juncture, and in academics there were good prospects that it would intensify its role as a gateway to scholarly exchanges. For Mathematics at HKU a program honored by his presence and leadership would be pivotal to giving shape to the Institute to be established, and we would do our best to involve mathematicians and students of Mathematics across Hong Kong and in the region, including a selected group of students and researchers in Mainland China. Very quickly Professor Borel laid out the format of such a program, if he were to come, which would be a twelve-month program in three phases, four months per year starting 1999, consisting of courses, lecture series and seminars. Colleagues in the Department would be involved from the very beginning in giving preparatory courses, and experts on various topics from around the world would be invited to give more advanced courses and lecture series.

We were delighted that in January 1998 Professor Borel accepted to take up the Distinguished Visiting Professorship at HKU. Quickly he drew up a general plan for the Program on Lie Groups. After a trip to the Chinese Academy of Sciences in May, he came with Mrs. Gaby Borel to pay a short visit in June to both HKU and to the Hong Kong University of Science and Technology (HKUST), and gave a joint Colloquium Lecture at HKUST entitled *Henri Poincaré and General Relativity*. While at HKU we worked out details for the program to take place in 1999. At the same time, they also picked a vacant University Apartment on the 14th floor of Tam Towers on Sha Wan Drive overlooking Sandy Bay, which was to become their residence for their visits March 1 - June 30 in 1999, 2000 and 2001. Later on I learnt from both of them and from their family and friends that they were enjoying the apartment very much during those stays.

The Program on Lie Groups kicked off in March 1999 with a series of lectures by Professor Borel giving a panoramic view on the theory of Lie groups and related developments, including automorphic forms, together with a number of introductory courses by colleagues in Hong Kong and visitors to the IMR on Differential geometry,

*Department of Mathematics, The University of Hong Kong, Hong Kong, China (nmok@ hkucc.hku.hk).

Lie groups, Lie algebras, and Lie groups over p-adic numbers. A course *Automorphic forms on $SL_2(R)$* was jointly offered by Jianya Liu, Yangbo Ye and Jianshu Li. Lecture series were then offered by R. Goodman on *Invariants of Classical Groups*, K. Brown on *Buildings*, Lizhen Ji on *Riemannian symmetric spaces* and Sai-Kee Yeung on *Geometric superrigidity*. It closed with Professor Borel's lecture *Some relations between representations of Lie groups and Physics*, and his concluding lecture on the first phase of the program.

In 2000 Professor Borel took up three full months of lectures, on *Lie groups and linear algebraic groups* and *Introduction to automorphic forms on reductive groups.* There was an introductory course on the spectral theory of automorphic forms by Jianya Liu and Yangbo Ye, and series of lectures *An introduction to infinite-dimensional representations* by N. Wallach, *Quantum groups and their representations* by H.H. Andersen, *Representation theory of real and p-adic reductive groups* by D. Barbasch, *Automorphic representations of Adele groups: mostly $GL(2)$* by S. Gelbart, and *Harmonic analysis on symmetric spaces* by Lizhen Ji. Seminar-type lectures included those by Weiping Li and Yongchang Zhu on *Infinite-dimensional Lie algebras, vertex algebras and applications to algebraic geometry*, and lectures by P. Sarnak on *Modular forms, L-functions and applications.* In the course of the program, to fill in some background Professor Borel also lectured on homological algebra, and Sai-Kee Yeung gave a few lectures on (co)homology theories. Lizhen Ji also gave a lecture *The Trace Class Conjecture and the Weyl upper bound on eigenvalues*, as a supplement to Professor Borel's lecture series on automorphic forms.

It was understood from the very beginning that the third phase of the program in 2001 would depend on the interests of the audience and may branch out to include topics that are related to Lie theory in a more indirect way. As it worked out, we had in that year more on geometric topics in addition to those on Lie theory and automorphic forms. There was a course *Introduction to symplectic and Poisson geometry* by Jianghua Lu, and series of lectures by Yongbin Ruan on *Stringy geometry and topology of orbifolds*, and by Y. Eliashberg on *Holomorphic curves in symplectic topology.* As to other series of lectures Professor Borel talked on *Introduction to Cohomology of Arithmetic Groups*, H. Nakajima on *A geometric construction on algebras*, Jianshu Li on *Singular unitary representations and applications*, J.W. Cogdell on *L-functions for $GL(n)$*, and Wenzhi Luo on *Topics on the analytic theory of automorphic forms.*

On top of the regular program we also scheduled occasional seminar lectures that were of interest to participants in the program, or that could lie on the interface of interests of different research groups. This is for instance the case of E. Zelmanov's lectures on *Kac-Moody algebras and Conformal algebras*, N. Wallach's lectures *Introduction to quantum computing*, A. Moy's lecture *Bruhat-Tits buildings and representation theory* and F. Shahidi's lecture *New instances of functoriality.*

The Program on Lie Groups met regularly two full days a week, supplemented by additional seminars, and tutorials for students where necessary. In addition to local participants, there were a number of participants from the region, primarily from China, but also from Japan and Singapore, with a variety of backgrounds in Lie theory, number theory and geometry. Some of the student participants from China have by now already launched their careers as mathematicians.

The subject of Lie Groups covers a vast territory of modern mathematics, and we are very fortunate to have had the privilege to run a program designed by Professor Borel, a grand-master in the subject. We are very much indebted to him, not only

for his leadership but also for his admirable dedication. He prepared his own lectures meticulously, distributed series of Lecture Notes on many occasions, discussed at great lengths with speakers, and made sure that students had enough exercises to acquire working knowledge on various topics. He laid out for us a panoramic view and a global perspective, and aspired participants to seek a level of excellence basing on solid knowledge of various structures and their intricate interrelationships. No one could have commanded as much respect as Professor Borel did to pull together researchers and students of such a variety of backgrounds. Through the Program on Lie Groups we made many friends from different parts of the world, and across tertiary institutions in Hong Kong it nurtured collaborative efforts among us. Right from the very beginning we conceived this to be not just a program at HKU, but also as a program for Hong Kong. In this respect we are especially grateful to colleagues from HKUST for sharing their expertise with us and for their enthusiasm.

While in Hong Kong Professor Borel followed a routine on exercises with an amazing rigor and discipline. Their apartment on Sha Wan Drive was at an ideal location for his daily exercises. Early in the morning he would swim at a University Swimming Pool, which is at a short walk from Tam Towers, and after breakfast he would take a Shuttle Bus to the University Sports Centre, which is en route to the campus, and did his exercises on weight-lifting, before starting his daily work at the University.

To those who did not know him well Professor Borel might appear too strict. He was in fact very friendly and straightforward, and, our lack of experience notwithstanding, he was very appreciative of efforts that were made. Especially, he was very happy with the secretarial help and the technical assistance that the Department was able to provide. It should be mentioned that our staff sometimes work long hours to assure the smooth functioning of activities at the IMR on top of the usual duties during term time.

Professor Borel was interested in Chinese culture and enjoyed talking about his experiences in China, especially at Dun Huang, where he made a trip in the early nineties after visiting the Chinese Academy of Sciences. Apparently, he knew a lot about the frescos in the caves there. While in Hong Kong he enjoyed visiting places with a strong local color such as Wong Tai Sin Temple and Cheung Chau (Long Island) during the Bun Festival, and took pleasure in taking a walk in some older parts of the town. From my interaction with him, Armand was very fond of Hong Kong. He appreciated the highly developed system of public transport in Hong Kong, which makes it very easy for visitors to move around, and enjoyed the many cultural events such as film festivals and concerts that were readily available. He also loved nature and enjoyed the many trails available to hikers. With Gaby he made trips to many outlying islands some of which are not even well-known to local people. He also enjoyed museums and parks in Hong Kong. I could recall that once when we visited Hong Kong Park together, Armand was amazed at the height of an aviary there. He told me that he had not seen a birds' house of that height, and appeared especially surprised because this was in a park almost in the centre of town.

Hong Kong offered to him also many beautiful views. HKU is situated on Hong Kong Island. From the back of the University there is a trail leading to Victoria Peak, and near the peak there is a circular path where one can have a panoramic view of Victoria Harbor. He enjoyed walking this trail with some of the participants. The walk was particularly popular since many of the invited speakers lived at Robert Black College, where the trail starts. He was also fond of taking the Star Ferry, and enjoyed

viewing the skyline of Hong Kong Island in the evening from Tsim Sha Tsui on the Kowloon side, especially after a good dinner there. Talking about food Armand and Gaby both enjoyed the many wonderful restaurants in Hong Kong, which vary from the very simple to the sophisticated, and with few exceptions they were very satisfied with the variety and quality of food at good prices available in Hong Kong. I can still remember very well the many joyful lunches and dinners we had together, mostly in Chinese restaurants, but also occasionally in Western including French restaurants, and their appreciation of the cuisine offered by Hong Kong.

We are indebted to Armand in many ways. The fond memory will stay on, and those who are fortunate to have gone through the program will remember the extraordinary experience of having taken part in Professor Borel's Program on Lie Groups held in this part of the world. We missed you.
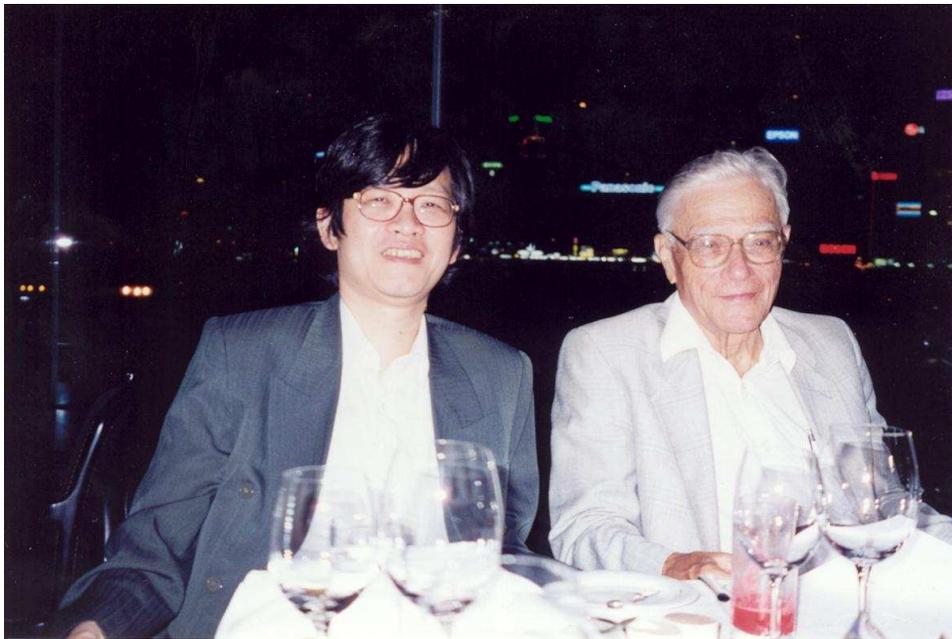
Picture of Professor Borel taken with the author in June 2001 in a restaurant
in Tsim Sha Tsui overlooking Victoria Harbor