

Report on the visit to Bhutan (November 24 - December 6, 2008)
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The context

In January 2008 R. Balamurugan (Assistant Professor at Sherubtse College, Kanglung, Bhutan) attended a CIMPA school in IIT Mumbai, Marc Chardin was one of the organizers, and this is where the idea of this visit arose in discussions between them and MW. This project was further discussed between Thinley Namgyel (Assistant Lecturer at Sherubtse) and MW at another CIMPA school in IPM Tehran in June 2008. It was finally decided that the visit would be done by SD and MW, while Marc Chardin might come later.

The main goal is to help the mathematical colleagues in Sherubtse College to have a strong program for mathematics: they just started this year (2008-2009) a new BSc program in Mathematics. The three first years are the same for the students in Maths-Physics and in Maths-Chemistry, a fourth year (Honors) proposes further courses of mathematics. Our first goal is to comment on this program and to suggest improvements for the next time it will be revised (2012). Some of the students who will complete this BSc program with Honors in mathematics starting in 2012 may wish to pursue their studies - the second goal of our visit is to propose a syllabus for a MSc program in mathematics. Our third goal is to comment on the program which will be proposed to the teachers in mathematics who will participate to a yearly one month postgraduate studies leading to a PostGraduate Diploma in Mathematics (PGDM), the first batch being scheduled for January 2010.

The colleagues who invited us also requested our help for the following:

- find out and brief them of the chances of offering the programme jointly by our University and RUB so that some kind of understanding on student's internship and faculty exchange can be reached.
- get them the twelve feet long chart released by IBM - Men of Mathematics
- provide them a Mapple 12 license.

We were able to bring a copy of the IBM poster. Marc Chardin discussed with them by e-mail the question of software - hopefully he will be able to come and settle the question here.

We also proposed to bring with us some books they cannot easily get. We received the list too late to bring all of them this time, we only brought 7 books of their list, 18 others will be brought in Bhutan by the next visitors.

The program

The visit started on Monday, November 24. In the Drukair flight from Delhi to Paro SD met M. Gyaltsen Penjor, Director, Royal Education Council. MW joined them in Kathmandu.

SD and MW were welcomed by Rinzin Namgyel, assistant Lecturer at Sherubtse College, who received his BSc in Singapore National University in 2007.

Meeting with M. Yangka on Monday, November 24

The same day we met M. Yangka Director, Academic Affairs office of the Vice Chancellor of RUB. We introduced the CIMPA, University Pierre et Marie Curie (Paris VI), The Institut de Mathématiques de Jussieu, we gave some information on the purpose of our visit, as explained above.

Further project arose during this discussion. One of them is to organize an international conference in Bhutan. The participants could be among the high school teachers in mathematics. There are some 200 of them in Bhutan, roughly half of them being of Indian nationality. The idea would be to ask some 10 foreign experts to organize this event. In order to guarantee the highest scientific level for this meeting we suggest that it takes place under the international committee of the International Mathematical Union dedicated to mathematical instruction, IMU-ICMI. For the funding of this conference, it was agreed that the Bhutan side will cover all local expenses, for external experts as well as for Bhutanese participants, while travel expenses for foreign experts will be covered either by themselves or by international organisations. There are some 15 mathematicians in Bhutan as teaching staff in high level institutions, including Sherubtse College - they should play a major role in this program, both during the meeting and after for the follow up. The information which will be gathered during the meeting should be distributed by them as well as by the other

participants to all teachers in mathematics in high schools in Bhutan.

The CIMPA will continue to invite participants from Bhutan to attend the international schools, including one in Lahore in February 2009 and one in Tehran in June 2009. Another CIMPA school is scheduled in Kathmandu in 2010.

We are willing to help our colleagues from Bhutan to develop their international contacts. Among the visits which would be very useful for them are those by Marc Chardin, already mentioned, also by Kanhaiya Jha, who is a professor in Kathmandu University and has contacts with mathematicians in a number of countries of the region, including Pakistan, India, Sri Lanka, Bangladesh, Malaysia, Singapour, Burma.

Meeting with Ms Kezang Doma on Tuesday, November 25

We met Ms Kezang Doma, registrar de RUB (we could not meet the VC, M. Pema Thinley, who was out of station). She was specially interested by the idea of Bhutan participating to the International Olympiads. We shall contact Paul Vaderlind, from the International Science Program ISP (supported by Swedish International Development Agency SIDA-SAREC), Uppsala University, Sweden who is member of the international organizing committee.

Meeting with Ms Françoise Pommaret on Tuesday, November 25

Françoise Pommaret is an expert on Bhutan. She gave us a lot of information and of very useful advices. The fact that we met her at the beginning of our visit helped us a lot to understand a number of situations.

Meeting with M. Gyaltsen Penjor on Tuesday, November 25

M. Gyaltsen Penjor is Director of the Royal Education Council. He told us about the project of magnet school (see below). We shall inform him of the development of our activity and seek his help. He also briefed us on his present plans of reaching agreements with various universities to accomodate students from Bhutan. An MOU with Columbia University for 5 students a year has been agreed upon. We shall consider having one with Paris 6.

Meeting with Sonam Togbay on Friday, November 28

On our way between Mongar and Trashigang, we met Sonam Togbay, who was the Head of the School of Mathematics and Computer Ccience until recently (he has been replaced by Sangay Thinley). We gave him a report on the visits we had in Thimphu.

Meeting with the Director of Sherubtse College, on Saturday, November 29 and Thursday, December 4, 2008.

We met the Director of Sherubtse College Singye Namgyel twice, firstly at the begining of our visit to Kanglung and at the end of our stay.

During the first meeting we explained the idea of having an international instructional conference, he pointed out that the College of Education should also be involved.

During our last meeting we reported on the main points of our visit. We received his agreement for having as much of flexibility as possible for the program of the third term in MSc: for Research Masters in the main international mathematical centers, the corresponding program changes every year, and is planed only a few months before the lectures start. To propose a syllabus several years in advance, as we did, is sensible only if it is taken as an example - the actual courses which will be taught should not be fixed so early, and should not be repeated from one year to the next.

We told him that we had a very fruitful interactive meeting with the students the same day. We discussed the possiblities of exchange of students and the question of credit transfer agreements.

He encouraged us to plan visits both from mathematicians from Bhutan abroad and from foreign mathematicians in Bhutan.

Meeting with the first year students in BSc from Sherubtse University on Thursday, December 4

On the afternoon of December 4 we had a meeting with some 60 students from the first year of the new BSc Program in Math-Physic, Math-Chemistry and Physics-Chemistry (also some more from the Computer Science Department but they had to leave near the middle of the meeting). MW gave a presentation of the CIMPA, next SD gave a mathematical talk on Diophantine tuples, then MW gave an introduction to Cryptography and Number Theory.

The most important part of this meeting was after these presentations when the students asked questions - some of them were excellent and this interactive discussion has been a high point in our visit.

Meeting with the mathematical teaching staff of Sherubtse University from November 28 to December 5

Last but not least, we had extensive discussions with the mathematicians from Sherubtse University during all our stay in Kanglung. These contacts have been extremely cordial and fruitful.

The Work completed in Sherubtse

We had several joint meetings with the faculty members of the Sherubtse college to review and frame the programs offered or to be offered soon in the College:

* *The present Bsc program.* A new fully RUB program has started this year and has been approved by the boards of the university. We went through it looking at the content of each module and to the inter-link between them. After a description of the aim and objectives of each of them, we offered our overall assessment and suggestions of improvements for the next revision. This detailed report has been given to the faculty in Sherubtse, and is appended to the present report. We just recall here our conclusion: the BSc program which starts has an international level and has been prepared very accurately. Our suggestions for improving it are not major ones.

* *The PGDM program.* This is a new program also, scheduled to be launched for next year. Its preparation was thus already in its final stages, though it is not yet fully finalised. In a specific session, we were briefed by the colleagues on its objective and also the time constraints faced, since it is to be offered to school teachers spread all over the country. This is a great initiative of the RUB that should be praised. We also went through the proposed draft and suggested some changes to improve it, taking into account that the student who will attend it are full time employed school teachers who will need some of the material for their own classes. Again, the detailed report has been given to the faculty in Sherubtse, and is appended to the present report. We also believe that the program offered will compete favourably with its international counterparts and will start on sound grounds.

* *The Masters program.* This program is still at the drafting stage, as it is presently scheduled to be launched in 2012. We had several sessions devoted to it, to properly define the objective and prospects of further learning or professional future of the graduates who will complete it. We have then suggested a detailed module by module decomposition with the major subjects that should be included. The proposal, along with guidelines for evaluation will also be appended to the present report and a copy has been handed over to our Sherubtse colleagues.

The first follow up action that could probably be taken would be a visit by Dr. Marc Chardin from our Institute of Mathematics, who is an expert in computational aspects of mathematics. This is a part on which we could not comment much upon (though it is becoming an increasingly important part of teaching programs), since it is not really within our field of expertise.

A small number of points of the proposed Masters program have also to be completed and we shall be able to come back to these after consulting with the respective experts of each fields in Paris.

Outlines of possible future action

Out of the several discussions we had both in Timphu and Sherubtse, we have identified three broad areas where future longer term co-operation would be useful.

* **Increase the exposition of Bhutan scientists and students to international developments, by visiting abroad.** In mathematics, we have been told that there are two young mathematicians who would need to quickly spend some time abroad to complete

their studies. The first is Thinley Namgyel who has a MSc from Newcastle University (Australia) and should get a scholarship to start a PhD. The ideal target for him seems to be not before September 2010. The second is Rinzin Namgyel: he has a BSc from Singapore University and should get the opportunity to attend a MSc course as soon as possible, hopefully as early as September 2009. We have been briefed on their files and will look for the best opportunities for them.

The other line of immediate action that could be taken is to ask the CIMPA to continue to invite participants from Bhutan to attend the international schools, to help a significant number of them to have an exposition to the present trends in mathematical research. On the longer run, one could envision some understanding between University Pierre et Marie Curie Paris 6 and RUB/REC, for admission of students in Paris 6 for advanced studies (Masters or PhD). This could even cover other fields than mathematics, but would require an MOU to be agreed upon and signed to be sustainable. We would like the Bhutan side to come back to us with a more precise estimate of how many students of good standard might be interested to send to France on average. The feasibility of credit transfer agreements will also be studied, and could be included in the above mentioned possible MOU.

*** Increase the exposition of Bhutan scientists and students to international developments, by hosting foreign visitors.** The target length of a visitor stay should be probably around one month. The various officials we met were briefed by us on the successful experience presently going on in Cambodia

<<http://www.cimpa-icpam.org/Anglais/Cooperations/Cambodia.html>>

which could serve as a general framework to be adapted to the Bhoutan specifics. It was agreed that the first step could be to start with some courses done in the set up of the planned PGDM program especially as this program is planned to propose intensive courses over a month period approximately. On the longer run, once the Masters program is started, one could envision that for example the third semester of the masters is taught on the basis of four successive modules each intensively dispensed over a month period (instead of four semester long parallel modules). Such an arrangement would permit to host four different experts each on a different field who would deliver a state of the art course. Again, we believe that passed the experimental stage, if the program is to be sustained by the French side over a longer period some kind of formal MOU would have to be agreed upon.

*** Increase the attraction towards scientific studies among Bhutanese youngsters.**

We were briefed several times about the difficulty the RUB faces to attract students in scientific studies and also on the acute shortage of mathematics high school teachers the country encounters. As a remedy, we would suggest a two step action. The first one would be to host an international conference under the sponsorship of some international body such as the IMU-ICMI, aimed at school teachers (such a sponsorship would serve both to provide better visibility and to ensure that the standards are comparable to the best events abroad). This could serve as a training camp for some high school teachers, who would be exposed to latest techniques as well as to academic mathematical content. It would also serve to provide international visibility on what happens in the country. If at least in the short term some kind of leadership would have to be provided by academics in Sherubtse college, the involvement of teaching oriented colleges would also be advisable. This initial conference could either be supplemented by a subsequent workshops conducted by the teachers having attended the first conference or by a subsequent conference aimed at a new batch of teachers. The general cost sharing principle could be along the following lines (budgets would have to be computed more precisely at the actual launching stage): local expenses for all participants (both from Bhutan and from abroad) would be met by Bhutan agencies and the travel expenses and other external costs of the foreign experts invited by international agencies. We are confident that we could find sponsorships for such an event for up to 15 foreign experts.

The second step we would suggest is to enrol Bhutan in the international Mathematic Olympiads program. This program could for example be launched with the above mentioned conference. To set up efficiently this program would probably require a few years, but each step would certainly help enhance significantly the scientific culture among high school children. The basic principle of a fully operational program would be as follows. Each higher secondary teacher sends his best pupils in mathematics to a district level training camps of about a week. The best pupils at each district level are then sent to national level training

camps where the final national team is selected and sent to compete in the name of the country for the Olympiad. Considering the challenging aspect of the question papers, the program leader for the country is usually a university professor (in the case of Bhutan, a Sherubtse professor). The rewards are huge considering the number of pupils that are involved in the different stages, and such a program could also fit well with the concept of Magnet schools envisioned by the Royal Education Council. Our side could help in the setting up of the program by organising training of the professors that would be in charge of the program, providing adequate material to the teachers (previous or similar question papers, appropriate further reading etc.) and assistance with the effective enrolment of the country. It might be useful that Sherubtse invites at some point Prof. Paul Vaderlind a Swedish mathematician involved in both the ISP (International Science program) and the International mathematic Olympiad. We could request the involvement of colleagues in charge of similar activities, for instance Dr Yogananda in India and J. Yebbou or C. Deschamps in France.

Finally, we shall brief the colleagues in Sherubtse on the Science festival that happens yearly in France and on the activities of the "Palais de la Decouverte" and of the "Cit  des Sciences et de l'Industrie" which specialise in explaining scientific phenomena to children of all ages through games and other ludic activities. Such experiences can also be a source of inspiration.

Conclusion

For the development of mathematics in Bhutan, the most urgent thing to do is to help the two more advanced bhutanese mathematicians to pursue their studies: Rinzin Namgyel has a BSc from Singapore University and should get the opportunity to attend a MSc course as soon as possible, hopefully as early as September 2009. Thinley Namgyel has a BSc from Newcastle University (Australia) and should get a scholarship to start a PhD. We are doing our best to help them in this respect.

We refer to our reports on the BSc Program and the MSc Program for further comments: let us only say that the BSc program which starts has an international level and has been prepared very accurately. Our suggestions for improving it are not major ones.

The PGDM is a very interesting initiative that we wish to support as much as possible - we may even consider to participate ourselves to the first intensive course scheduled in January 2010.

We are fortunate to be witness of the birth of a new mathematical school. It will take time, but on the long run (maybe 15 years) we expect that there will be a reasonable number of Bhutanese mathematicians with a PhD, with active mathematical researches going on in Bhutan. To launch a laboratory in mathematics devoted to advanced researches is too early at the present stage, but it should be a goal for having a strong staff in the University with an international level, and this will be necessary to improve the level of mathematical teaching at all levels, not only in the universities and the engineers schools but also the high schools.

Thanks

We are very thankful to Rinzin Namgyel (who came all the way to greet us in Paro and joined us from Paro to Kanglung), to Marc Chardin (who started the first contact with Balamurugan and helped us to prepare this visit), R. Balamurugan who initiated this visit and organized it, Singye Namgyel who welcomed us in the College of Science of which he is Director, Yangka, Ms Kezang Doma, Fran oise Pommaret and Gyaltsen Penjor for the fruitful meetings we had with them, all the colleagues from Sherubtse College who have been extremely kind and helpful, in particular Rinzin Namgyel, Thinley Namgyel, J. Lalitha Jasmine, G. Vijaya Kumar, Gopalakrishnan, Samir Patel. We received useful information from several colleagues abroad, including Prof. Nick Gill and Dr L. Fushnansky.

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This report is available on the internet at the URL

<<http://people.math.jussieu.fr/~miw/articles/pdf/BhutanSDMW2008.pdf>>