

The Abdus Salam School of Mathematical Sciences in Pakistan

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A critical partner in the fight against terrorism, Pakistan has often been in the news lately; unfortunately much of the news is bad. Beset with political instability, economic inequality, ethnic strife, high-profile assassinations, religious extremism, government corruption, sectarian violence, and natural disasters, the country faces almost insurmountable challenges.

Pakistan shares with India a long and glorious past. Following a succession of ancient empires, Great Britain gained control of the Indian subcontinent in the mid-nineteenth century. In 1947 British India was partitioned along religious lines into two states. The predominantly Muslim areas became the Islamic Republic of Pakistan, which later separated into present-day Pakistan and Bangladesh, and the rest became the secular Republic of India, whose inhabitants are mainly Hindu. Unlike in India, mathematics had long been neglected as an area of research in Pakistan.

In 2003, recognizing the need for training in advanced mathematics, the Higher Education Commission of Pakistan and the provincial government of Punjab, the largest and economically most important province of Pakistan, founded the Abdus Salam School of Mathematical Sciences (ASSMS) at Government College (GC) University in Lahore. The school takes its name from Abdus Salam, a Pakistani Nobel laureate whose Nobel Prize was in physics but who had studied and taught mathematics at GC University. With a population of more than seven million, Lahore is the second largest city in Pakistan and is its intellectual, cultural, and artistic capital. The seat of the Mughal empire in the late sixteenth century, Lahore has mosques and palaces that rival Versailles in their scale (Figure 1).

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Although affiliated with GC University, the Abdus Salam School of Mathematical Sciences is an autonomous unit with its own faculty, funding, and admission of Ph.D. students. Even its building is not on the campus of GC University. Housed in a nondescript, unmarked, low-hung building in a residential area in the heart of Lahore, protected by a large, heavy metal gate behind high walls, the school is hardly noticeable (Figure 2). On my recent visit, the director-general of the school, Dr. A. D. R. Choudary, told me that the anonymity of the building and of the location is intentional, for it contributes to the security of the school.

Faculty

Among research and educational institutions in mathematics, the Abdus Salam School of Mathematical Sciences is unique in many ways. It is a doctoral school in mathematics with no undergraduates. Reflecting the state of mathematical training in Pakistan, its faculty is entirely foreign. Moreover, every professor has a joint appointment either as a regular or as an emeritus faculty member at a foreign university or institute. This fact alone guarantees a level of quality unmatched in other Pakistani institutions. Most of the professors have positions in Eastern Europe, but a few come from France, Germany, Britain, and Norway. In a country where the average per capita income is less than two dollars a day, it is difficult for the school to offer salaries competitive with those of the West. Clearly, for a foreign mathematician to work at the Abdus Salam School, a certain measure of idealism is required. Fortunately, the cost of living in Pakistan is low, and one can live very well on a local professor's salary.

There is no permanent faculty, but many professors come regularly enough that the school not only functions but has achieved an enviable level of success. Some professors discharge their teaching duties at their home institution in one semester and come to the Abdus Salam School in the other semester; others, located at research institutes, have more freedom of movement; still others come

during semester breaks or summer months. Those who are emeritus in their own institution can of course accept a full-time appointment at the Abdus Salam School. The research expertise of the forty some faculty members spans all areas of pure and applied mathematics, from algebra and number theory to geometry, topology, analysis, dynamical systems, combinatorics, mathematical physics, probability, and financial mathematics.

Program

The Abdus Salam School provides all of its students with full tuition support and living expenses for five years. Each year twenty students are admitted based on a competitive entrance examination. While some Pakistani students do go abroad for graduate study, most do not. The students at the ASSMS are the cream of the crop of those who stay in Pakistan, a factor that may help explain the high graduation rate at the end of five years at the school. In a male-dominated Muslim society, it is surprising to see a strong contingent of female students. Of the eighty-four full-time students currently pursuing a Ph.D. degree at the school, twenty-five are women (Figure 3).

In their first year, all students take ten required courses, in Linear Algebra, Algebra I and II, Real Analysis I and II, Geometry I and II, Complex Analysis, Number Theory, and Differential Equations. In their second year, the students take more advanced required and elective courses from a large number of choices, depending on the faculty available. One of the more unusual Ph.D. requirements at the school is that a student must have a paper accepted in an internationally recognized journal, such as the ones on the list established by the ISI (Institute for Scientific Information), before the thesis can be presented for the degree. This requirement, which ensures that every thesis meets a minimum internationally recognized standard, is unheard of at American universities but is especially important in a country such as Pakistan for the degree to have credibility.

It is an impressive achievement that, even with this publication requirement, in the short span of eight years since its founding in 2003, the Abdus Salam School has produced fifty-eight Ph.D.s in mathematics, of whom nine are women. Even more remarkable is the fact that, of the fifty-eight, all except one are now employed as faculty at universities and institutes throughout Pakistan. The Abdus Salam School is clearly serving an important societal need in Pakistan. In addition to training Ph.D. students, the school has a postdoctoral program for new Ph.D.s from abroad and a training camp to prepare talented Pakistani high school students for the International Mathematical Olympiad. In a multipronged approach to the promotion of mathematics, the school organizes mathematical contests for young students throughout Pakistan,



Figure 1. Lahore Fort in Lahore, Pakistan.



Figure 2. The courtyard of the ASSMS.



Figure 3. Students enjoying Pakistani treats.



Figure 4. The author in Pakistani garb with Director-General A. D. R. Choudary (fourth man from left, in white) and some of the faculty and students at the Abdus Salam School.

as well as international conferences for research mathematicians.

Crisis

In spite of the school's service to the nation, the outlook for the ASSMS is not rosy. In the summer of 2010, heavy monsoon rains flooded one fifth of Pakistan, creating a humanitarian, medical, and economic crisis of unprecedented proportions. Whether as a response to this or some other crisis, the government cut the budget of the ASSMS by 50 percent. For the first time in its history, the ASSMS did not admit a first-year class. What the future holds is anyone's guess. The fact is, it is difficult to make a case for theoretical mathematics when millions of people, displaced from their homes, lack food, clean water, and medical care.

The 50 percent cut to its budget underscores the precarious financial foundation of the ASSMS and the need for an endowment. By American standards, the amount needed is not large. For example, at the current rate of return in Pakistan, the income from an endowment of \$25,000 can provide the annual living expenses for one Ph.D. student.

Visitors

Another way the international mathematical community can help is for eminent mathematicians to give lectures, offer courses, or advise students at the ASSMS.

In hosting international visitors, one obstacle unique to Pakistan is the issue of security. Various Western governments, including those of Australia, Canada, France, and Switzerland, have issued travel warnings advising their citizens against visiting Pakistan except in case of family or professional necessities. The State Department of the United States does not go so far, but it issues a list

of risks long enough to scare off potential travelers. During my two-week visit to Lahore in January 2011 (Figure 4), the only Westerners I saw were the foreign faculty at the ASSMS. None of them have ever had a bad experience in Pakistan, nor have they heard of any incidents involving foreigners in Lahore. It may be that the small size of the foreign population in Lahore makes it an unnoticeable or unattractive target.

Whatever the security situation may be, the Abdus Salam School takes good care of its faculty. All the foreign faculty are housed in mansions in a safe neighborhood on the outskirts of Lahore. Both the faculty housing and the school itself are patrolled by armed guards twenty-four hours a day. Every day the school provides vans to transport the faculty between the housing and the school. At the faculty residences, in-house chefs prepare meals for all the faculty, and custodians clean the houses. Laundry can be sent out and will come back cleaned and pressed. With the mundane daily affairs taken care of, if they wish, the faculty can devote all their time to mathematics.

Religion

Religion permeates every aspect of life in Pakistan. Upon arrival at the airport, the luggage goes through a scanner. If the scan shows anything resembling a bottle, the luggage is opened and bottles containing alcohol are confiscated.

I had been warned not to bring alcohol into Pakistan, but I did bring from Paris some expensive chocolates filled with brandy, Cointreau, or cognac. Surely eating liquor-filled chocolates does not count as drinking! My chocolates made it through customs with no problem, but, alas, I could not give them away. On being told the alcohol content of the chocolates, my Pakistani hosts, the Pakistani staff at the school and at the residence, and the



All photographs courtesy of the author.

Figure 5. The mathematics library at the ASSMS.

students all politely declined my offer. In the end, I gave the chocolates to the foreign faculty and the foreign-born non-Muslim mother-in-law of a staff member.

The first morning, at 5 a.m., I was roused from my slumber by a persistent chant that seemed to envelop the entire neighborhood. It was the call to morning prayer. A devout Muslim prays five times a day. In every neighborhood there is a mosque, and the minaret of the mosque is usually fitted with a powerful loudspeaker that broadcasts the call to prayer, or *adhan*. The call can last twenty minutes. I adapted by going to bed early in order to wake up with the call to morning prayer.

The seriousness of religion in Pakistan can be seen in the debate about the blasphemy laws that make insulting Islam a crime punishable by death. In November 2010 a Christian woman was sentenced to death by hanging under the blasphemy laws. She was accused of having made derogatory comments about the prophet Muhammad, but there are those who think that the blasphemy laws are being used to settle personal vendettas. Lawmakers who try to repeal the blasphemy laws run considerable risks. On the second day of my visit, the governor of the Punjab province, Salman Taseer, a reform-minded Muslim, was shot to death by his own bodyguard. Universities and government offices closed, and my lecture for the day was canceled. Within two months, the federal minister of minority affairs was assassinated, also for supporting the reform of the blasphemy laws. The case of the Christian woman is under appeal, but the movement to reform the blasphemy laws is stalled.

Health Concerns

Before my trip to Pakistan, I went to the Travel Clinic at Massachusetts General Hospital and got, at considerable expense, seven different immunization shots, as well as medication against malaria.

The malaria medication was to be taken every day while in Pakistan and for seven days after leaving. I also brought with me a can of insect repellent. All of this turned out not to be necessary, at least not in Lahore. None of the foreign faculty at the Abdus Salam School had gotten any immunization, and they have been perfectly fine. Moreover, Lahore has no mosquitos in the winter months. I stopped the malaria medication two days after arrival and experienced no health problems while in Pakistan.

Internet and Library

Wireless Internet works surprisingly well in Lahore. It seems that the entire city is covered with wireless Internet. With a special USB key from the Internet service provider plugged into my personal laptop, I was able to access the Internet from anywhere in the city.

With the availability of the Internet, the library at the Abdus Salam School can dispense with hard copies of journals and rely on online subscriptions to major mathematical journals (Figure 5). As for books, it is a different matter. While the library has most of the standard reference books in each field, its book collection as a whole is small. Moreover, the students simply do not have the means to buy original editions of books published in the West. With more and more books becoming electronic, perhaps the situation will become better in the future.

Power Shedding

In spite of my extensive experience in international travel, it was in Pakistan that I encountered for the first time the phenomenon of “power shedding”. On the day of my arrival, I was writing up some lecture notes at 6 p.m., when the room suddenly went pitch black. In fact, the whole neighborhood went dark. My Pakistani caretaker, Fareed, assured me that power would come back at 7 p.m. It turned out that, in an effort to save energy, the government shuts down power five times a day for an



Figure 6. Jahangir's Tomb in Lahore, Pakistan.

hour each time. This is called “power shedding”. Power shedding rotates among neighborhoods, with different neighborhoods losing power at different times. Large stores and institutions usually have their own backup generators so that they can go about their business. For a mathematician, it is indispensable to have a battery-powered laptop. Fortunately, wireless Internet continues

to be available even during periods of power outage. I was told that power shedding had been going on in Pakistan for thirty years. With the safety of offshore oil rigs in doubt and nuclear power under a cloud, could power shedding be in America's energy future?

Students

At the Abdus Salam School I gave a series of twelve lectures on equivariant cohomology, assuming a basic knowledge of manifolds and cohomology and ending with a proof and some applications of the equivariant localization theorem of Atiyah-Bott and

the impression that at least a few are comparable to the best students in a good American graduate program. The problems they work on, say on exceptional Lie algebras or on configuration spaces, seem to me quite mainstream and constitute interesting mathematics. The students seemed motivated and eager to learn, for there was little attrition throughout the twelve lectures.

University of the Punjab

The Abdus Salam School is located not far from the University of the Punjab. One day a graduate student, Waleed Noor, from the Abdus Salam School took me to the University of the Punjab for a visit. In Waleed, I found a perfect guide to Pakistani culture. The first striking fact about the University of the Punjab campus is the preponderance of female students, all with headscarves and in full-body cloaks, some even in niqab that covers most of their face. The university's student body is 70 percent female. One reason may be that girls are more studious and obedient in high school and do better on exams. Since admission to a university is based on an entrance exam, there would be more female undergraduates. At the University of the Punjab, the mathematics department has four hundred mathematics majors, of whom three hundred and fifty are women, a marked departure from the ratios in the United States. However, progressively fewer women pursue advanced studies, and even fewer enter the work force. My Pakistani hosts offered the explanation that most women in Pakistan still prefer the traditional role of a mother and housewife. My own unscientific survey was too limited to conclude if the dearth of women in the



Figure 7. Details of Jahangir's Tomb.

Berline-Vergne. About two dozen people, mostly students but also some faculty, attended the lectures. From the questions, I could tell that some of the students were following the lectures closely. I spoke with students outside the classroom and had



Figure 8. Donkey carts are a common sight in Lahore.

work force was out of preference or due to gender discrimination and peer pressure.

I asked a group of female mathematics majors whether, given the lopsided sex ratio at the university, there is intense competition for a male date. They said, “We don’t date. Our parents will find husbands for us.” Most marriages in Pakistan, even among the highly educated segment of the population, are still arranged. Both men and women seem content with the arrangement, because “our parents can cast a wider net.”

Lahore

Much of Lahore today is not beautiful, but it has breathtakingly beautiful sites that recall its former splendor. Both the Lahore Fort and the Shalimar Garden have been designated as UNESCO World Heritage Sites. The photos I took of the Lahore Fort and of Jahangir’s Tomb (Figures 1, 6, and 7) share a common feature—the absence of people. There are no tourists in Lahore to speak of. Foreigners have been scared away, and the locals, for whatever



Figure 9. Rickshaws serve as taxis in Lahore.

reason, do not throng to their cultural heritage, and so the monuments stand in splendid isolation.

The ubiquity of donkey carts adds an Old World charm to daily life in Lahore (Figure 8). Rickshaws, which are motorized tricycles that serve as taxis in Lahore, weave in and out of traffic (Figure 9). In a city of seven million without a subway, traffic jams are to be expected.

The lack of a tourism industry means that it is not easy to find picture postcards. According to the locals, postcards might be available in the Lahore museum, but no one seemed to have seen one. I never made it to the Lahore museum; the thought of getting caught in traffic jams was enough of a deterrent.

Shortly after I left, an American, Raymond Davis, was arrested in Lahore for killing two Pakistanis. According to Mr. Davis, who turned out to be a CIA contractor, the two Pakistanis were trying to rob him at a traffic jam and he acted in self-defense. Whatever the truth may be, this appeared to be an isolated incident. I felt safe walking freely about the city in January 2011. However, with the tension generated by the killing of bin Laden, the security situation for American visitors in Lahore may have become more fluid.

Conclusion

Terrorism and lawlessness thrive when a population lives in misery. While the development of mathematics cannot be expected to solve all the ills of a society, it is a step in the right direction. The Abdus Salam School of Mathematical Sciences is training mathematicians versed in modern mathematics to serve as future faculty in Pakistani universities. It is an important mission. It would be a pity if its programs were curtailed because the Pakistani government is overwhelmed with competing demands. Those of us fortunate enough to work in the West can lend a helping hand. In the case of the Abdus Salam School, even a small gesture can go a long way. For more information about the school or to make a donation, visit <http://www.sms.edu.pk>.