Hyderabad to host International Congress of Mathematicians

In the year 2010, the city of Hyderabad will host an event of great significance. The 'International Congress of Mathematicians' (ICM), which was held for the very first time in 1897 in Zurich, will be held in Hyderabad. The Congress, convened by the International Mathematical Union, is an event that occurs every four years. Since the first assembly in Zurich, except for the period corresponding to the time of the two World Wars, the Congress has been a regular event. This is the first time that the Congress will be hosted in India, and it will be one of the few occasions that the Congress has travelled outside of Europe and the United States.

The opening ceremony of the Congress will see some exciting moments. The prestigious Fields Medal, the Nevanlinna Prize and the Gauss Prize are traditionally awarded to mathematicians of repute during the opening ceremony. Of these, the Fields Medal is the most prestigious and has often been called the 'Mathematics Nobel'. First awarded in 1936, this prize is given every four years to between two and four mathematicians and carries a cash prize of around US$ 15,000. The Fields Medal is awarded to mathematicians who are less than 40 years of age.

Tracing the history of the Congress throws up some unexpected insights. The 1897 Zurich Congress was initiated by the French and the Germans. This was the period in history when Europe was at the forefront of mathematical research and study. The proceedings of the first Congress were recorded in French and German, with talks being presented in different European languages. As such, the proceedings are a glimpse of a world in which English was not yet the dominant language of communication. There were in fact many proposals in Europe at that time that a new 'international auxiliary language' be devised to be used for communicating between people with different native languages.

Writing in the September 1897 issue of *Science*, American mathematician George Bruce Halsted[1] reported that the Congress was in 'every way a success . . .' and that the '. . . the actual program was particularly rich and interesting'. He noted that 'The greatest mathematician in the world Sophus Lie was not expected; and the greatest French mathematician, Poincare, though down for a speech, did not come; . . . '. There is also one other sentence in this report which I cannot resist quoting here. Halsted says '. . . The second section contained a title from Z. de Galdeano, whose heroic efforts gave Spain a *Journal of Mathematics*, now unfortunately dead in the decadence of that beautiful, priest-ridden land'[1].

At the first gathering, the purpose behind the regular future meetings was also decided and these were to be '(1) to promote personal relations between mathematicians of different lands; (2) to give, in reports or conferences, an aperçu of the actual state of the diverse branches of mathematics, and to treat questions of recognized importance; (3) to deliberate on the problems and organization of future congresses; (4) to treat questions of bibliography, of terminology, etc. on subjects where an *entente international* appears necessary'[1].

The next Congress was held in Paris in 1900. It was at this assembly that the German mathematician David Hilbert announced his famous list of 23 problems in mathematics, now known as Hilbert's problems. Hilbert is said to have presented his problems with the following opening lines 'Who among us would not be happy to lift the veil behind which is hidden the future; to gaze at the coming developments of our science and at the secrets of its development in the centuries to come? What will be the ends toward which the spirit of future generations of mathematicians will tend? What methods, what new facts will the new century reveal in the vast and rich field of mathematical thought?'[2]. As it turned out, the problems Hilbert discussed formed a large part of 20th century mathematical study. Among the 23 problems Hilbert presented to the world, some were solved fairly quickly, some were decided to be irresolvable, and some remain unresolved even now.

The World Wars threw their shadows on the mathematical community. After the First World War, an International Research Council was set up by the countries that had won the war, but those that had lost the war were not allowed to participate. This Council included an International Mathematical Union (IMU). At the 1920 ICM in Strasburg, the statutes of the IMU were decided on, but Germany was excluded from participation. This state of affairs continued until the 1928 ICM at Bologna, from which point onwards the Congresses was open to all mathematicians, irrespective of nationality.

Although at the 1936 ICM at Oslo it was decided that the next Congress would be in USA in 1940, because of the Second World War it only took place in 1950 at Berkeley. This time, participation was solicited from mathematicians from any part of the world, irrespective of nationality. It was also at this ICM that the host Americans took efforts to revive the IMU, which had not been playing an active role in international mathematics until then. After this point the IMU played the lead role in arranging future meetings. For the earlier congresses, at each event the venue of the next meeting would be decided upon and the rest left to the host country to organize. However, the Congresses starting with the one in 1962 in Stockholm have been organized with joint participation between the host countries and IMU[3].

The Fields Medal was instituted and first awarded at the 1936 ICM to Finnish mathematician Lars Ahlfors and American mathematician Jesse Douglas. At the last ICM in Spain (2006), an event that caught the attention of the popular press was the refusal of Russian mathematician Grigori Perelman to accept the medal.

Indian participation in the ICM has been qualitatively significant. The schedule of each Congress includes some 200 invited talks. To be invited to deliver a talk is considered a matter of great prestige. Since the 1958 Congress, except for the one in 1986, there has been at least one invited talk by an Indian mathematician living and working in India[4].

The last Congress in Spain was an eight-day event attended by about 4000 participants from all over the world. This gives some idea of the scale and scope of the event. In India, the National Board of Mathematics, under the aegis of the Department of Atomic Energy, is responsible for the promotion of higher mathematics. Four Indian mathematicians

represented the country at the Meeting of the IMU General Assembly in Santiago de Compostela, Spain in August 2006 and bid successfully for ICM 2010. An Executive Organizing Committee was set up and has been meeting regularly to oversee the preparations for ICM 2010. The event will take place between the 19 and 27 August 2010 at the Hyderabad International Convention Centre.

1. Halsted, G. B., *Science*, 1897, 402.
2. Wikipedia
3. Cassels, J. W. S., *Not. Am. Math. Soc.*, 1998, **46**, 1230.
4. Raghunathan, M. S., 2005 Seminar, 547.

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Shanta S. Rao Award

The Thirteenth Memorial Award was conferred upon Prof. A. Jagannadha Rao, Raja Ramanna Fellow, Department of Biochemistry, Indian Institute of Science, Bangalore, at the National Institute of Research in Reproductive Health (NIRRH) on 21 April 2009. Shanta S. Rao was Founder Director of the Institute for Research in Reproduction (NIRRH, Indian Council of Medical Research (ICMR), Mumbai). The oration award dedicated to her memory was instituted in 1980 to be awarded for eminent scientists who have made pioneering contributions to the field of reproduction.

Shanta S. Rao began her research career as a biochemist in 1956 at the Indian Cancer Research Centre in the then Contraceptive Testing Unit (CTU). In 1963 this unit came to be known as the Reproductive Physiology Unit (RPU), which eventually under her leadership was expanded in February 1970 as the Institute for Research in Reproduction (IRR). It was her singlehanded effort that led to the establishment of IRR as a permanent institute under ICMR, dedicated to the field of reproduction. She remained its Founder Director till her untimely demise in December 1979, at the age of 56.

In later years as human reproduction gained greater national relevance, the institute mandate was expanded and it was renamed in July 2002 as National Institute of Research in Reproductive Health.

There have been several problems in developing a reversible male contraceptive till now. Research scientists opt for blockade of follicle stimulating hormone (FSH) or FSH receptors; interfering with sperm maturation or interfering with estrogen hormone action or by immunization against epididymal or sperm specific proteins. Several studies on epididymal functions and sperm maturation have shown that epididymis could be one of the best target organs of male contraception. According to Jagannadha Rao too, blockade of epididymal functions could be a likely contraceptive target.

In his oration lecture, Rao presented his work on the insights into the role of FSH and estrogen in regulation of epididymal function in monkeys and rodents. Efforts are also in progress to establish the role of estrogen in regulation of genes involved in fluid absorption in epididymis using rat and monkey as a model.

Epididymis is a part of the male reproductive system; a tightly-coiled tube connecting the efferent ductules from the rear of each testis to its vas deferens. It is divided into three parts, caput – head, corpus – body and cauda – tail. Sperm formed in the testis, the male gonad, enter the caput epididymis, go to the corpus, and finally reach the cauda region, where they are stored. Sperm entering the caput epididymis are immature and immotile; they lack the ability to swim forward and fertilize the ova or egg. During their transit in the epididymis, these undergo maturation to be able to fertilize the egg. The function of efferent ductules (ED) is mainly sperm transport and water resorption.

In a study carried out by Rao, when immature rats and adult bonnet monkeys were deprived of FSH, degeneration or atrophy, especially of the cauda region was observed. This showed that epididymis is a direct target for FSH action and that FSH plays a role in regulation of growth of the epididymis.

The fact that estrogen is suggested to play an important role in sperm maturation, shows that there may be a possibility of interfering with estrogen action at the epididymal level. The best way to study the effect of lack of estrogen on epididymis is to use estrogen receptor (ER) antagonists. Rao's research, which involved chronic administration ICI 182870, a specific estrogen receptor antagonist, in adult male bonnet monkey, revealed a drastic decrease in sperm motility. ICI treatment in male rats also led to decreased fertility. Similarly, following chronic administration of TMX (tamoxifen), another ER receptor antagonist, the adult male bonnet monkeys were found to be infertile with severe abnormalities in sperm morphology and decreased motility.

When ICI was administered to male mice for 35 days, it produced α-Estrogen Receptor Knockout mice (α ERKO-effect). Impaired sperm production in male αERKO mice was observed and this was possibly due to the disruption of estrogen action.

In another study, ICI treatment on the caput region of the bonnet monkey epididymis was examined. For the first time, evidence was provided by Rao about the presence of estrogen receptors, ER-α and -β, in all the three regions; caput, corpus and cauda of the bonnet monkey epididymis.

According to Rao, among the various approaches for male contraception, immunization using either FSH or FSH receptors or peptides appears effective as the efficacy and reversibility have been clearly established. The practical application of methods of male contraception based on the above findings may take time and considering this the option left for male contraception for the time being is the age-old approach of barrier method or vasectomy.

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