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mathema

Is Mathematics the Language of Nature?

6 November 2008 to 2 August 2009

Press Conference
4 November 2008
11:00 a.m.

**With introductory
remarks by the
president of the
German
Mathematical
Society, Professor
Günter M. Ziegler**

**Accreditation with
fax number or at
info@sdtb.de**

In conjunction with the scientific year of mathematics, the German Museum of Technology has produced an extensive exhibition to pose the question, "Is mathematics the language of nature?" Under the patronage of Dr. Annette Schavan, minister of education and research, *mathema* invites the visitor to explore the secrets of the world. Mathematics is an integral part of our thinking and being. It helps us to understand the structures of nature. Our knowledge about the world, our understanding of its laws, as well as technological developments are directly related to our mathematical knowledge.

A new and vital picture of mathematics is presented in a 1000-square-meter exhibition space. It was conceived by Hadwig Dorsch, director of calculation and automation technology at the Technological Museum, and Dr. Ehrhard Behrends, Department of Mathematics and Computer Science, at the Free University Berlin. The German Telecom Foundation is supporting *mathema* with a leading grant of 200,000 euros. The exhibition is accompanied by work of contemporary artists on the subject of cryptography and by a handsome children's area—*mathema* for Children—with numerous experiments and games for 4- to 10-year-olds.

Mathematics is part of our culture. A number of media are employed in the exhibition to impart this truth vividly. In addition to texts and "classical" museum exhibits, there is an interactive program, films, and numerous exhibits that have been largely conceived for *mathema*. The scope, the depth of information, and the breadth of variety of the presentation are unique for an exhibition on mathematics.

"Mathematics is the language of nature" —Galileo Galilei

The motto of the exhibit is based on a famous statement of Galileo that mathematics is the language of nature. In an audio installation in the entrance room, one can hear a number of opinions about the nature of mathematics. Some of the words are those of Goethe, Kant, and Einstein, but there are also the voices of children, with their seemingly naive questions.

"Number," "Geometry," "Functions," "Chance," "Limits"

Five thematic rooms are devoted to the role of mathematics in our culture. Four of these rooms ("Number," "Geometry," "Functions," "Chance") relate to the world of the visitor's everyday experience. The fifth room ("Limits") deals with the importance of mathematical knowledge to an understanding of our world. Each room presents a time line of the historical development of the given aspect of mathematics.

“Number”: On What Do We Reckon?

Numbers set the course of our lives. Since ancient times, they have served mankind in bringing order to the world. The importance of numbers for commerce, technology, and science is well known. Yet numbers also play an important role in music and art. Among the topics considered in the room “Number” are these: the universality of mathematics (Film: “Carnival of Numbers,” 2008); the construction of musical scales according to mathematical principles; the contemporary science of cryptography, knowledge of which is crucial for online banking and other Internet transactions; the golden ratio in art; from early calculation as rarefied knowledge to mathematical understanding as a general good (Adam Ries house). The exhibition also shows the development of various calculational aids from early times to the present. Since the dawn of the modern era there has been a significant increase in the number and complexity of calculational problems to be solved.

“Geometry”: What Are the Shapes That Make Up Our World?

In the earliest advanced cultures (for example, the Egyptians and the Mayans), complex mathematical procedures were implemented in astronomy, land surveying, and architecture. The measurement of land (“geometry”) is one of the oldest mathematical disciplines. Since the beginning of the modern era, a number of mathematical theories have been developed that play a crucial role in providing an understanding of today’s scientific worldview. The theory of relativity is unthinkable without the geometry of curved surfaces and the generalization of the notion of dimension beyond the three dimensions of our experience. The area “Geometry” illustrates these developments from the beginning to the world mapping capabilities of GPS technology, which itself relies on the special and general theories of relativity. There is also on offer a journey into the fourth dimension, and several exhibits are devoted to the topic of symmetry (giant kaleidoscope, mirror exhibits).

“Functions”: How Does Nature “Function”?

Modern mathematics begins with the successful conception of motion as a mathematical function. Today, the idea of function pervades every corner of the mathematical sciences. Any motion—indeed, change of any sort—can be described by a mathematical function. In this area of the exhibition, visitors will learn about the relationship between distance traveled, velocity, and acceleration and how this relationship can be expressed and graphically represented by mathematical functions. In the “Flight over Vienna” (only virtual, of course, alas, but quite realistic and undertaken with strapped-on Daedalus wings) and in “walking a function,” the visitor can see how his or her own motion can be transformed into a function. There is also “mathematics for the ear” to be heard in this room. What functions arise when one plays the piano or when one speaks? How can one convince oneself that all sound-producing vibrations are composed from set of common building blocks?

“Chance”: Can Luck Be Commanded?

Chance plays a role in a number of aspects of our daily lives. The associated mathematical theory, which developed relatively late (in the seventeenth century), allows us to say something about probabilities of outcomes in lotteries and at the roulette wheel, to compare the values of insurance policies, or to give valid interpretations of statistics. The topic “games of chance” occupies a prominent place in this exhibition. In addition, some fundamental questions are raised: What are the limits of predictability? How can chance be used productively—for example in determining an optimal travel route? What is the role of chance in the nanoworld? Can one beat lady luck? An additional focus is the modern mathematics of finance, an extremely current new field that is undergoing rapid development.

“Limits”: Is Mathematics Limitless?

With the help of mathematics we can move beyond many boundaries into areas that are inaccessible to our direct perception or imagination. Therefore, mathematics is often viewed as a sixth sense. For example, the infinite is a conundrum to us and in many ways ungraspable. At the same time, however, it serves as the backdrop to many mathematical proofs. A film on the “parable of the rice grains” and exhibits on mathematical record holders clarifies for us how limited is our ability to grasp exponential growth.

And the following question is discussed: to what extent can the world be understood using mathematical methods? One point of view is that of David Hilbert, with his assertion, “We must know. We shall know” (1930), which was immediately refuted by Kurt Gödel. In the center of this room is an exhibit on the almost mysterious relationship that mathematicians call the “most beautiful formula.”

Mathematics in Art

Encryption–Decryption: Mathematics in Contemporary Art

Mathematics has entered contemporary art in a variety of ways. For “Encryption–Decryption,” Professor Dietmar Guderian has selected items that deal with the application of computers to cryptography; indeed, the encryption of everyday numbers and letters into the binary system is the basis of every computer application. The art exhibition presents works by noted artists that take various perspectives on the theme of encryption: Josef Linschinger, A.R. Penck, Waltraut Cooper, Klaus Schneider, Karsten Panzer, Karl Herrmann, and artplosion.

Especially for Children

The *mathema* exhibit for children aged 4 to 10 will awake the curiosity and creativity of young museum-goers. They will carry out a variety of experiments under pedagogical supervision and experience through play the foundations of mathematics. They can weigh numbers on the “number scale,” handle geometric forms, and find out how cars can travel with square wheels. This area was designed by Dr. Renate Puchta, of Vierstein Verlag.

Tuesday–Friday 9–13 for groups with reservations: Tel.: 030/90254124 or Fritzsche@dtmb.de
 Tuesday–Friday 13–17:30 and Saturday–Sunday 10–18 for all (no reservation required)

Companion Program

A continually varying companion program (workshops, films, lectures, guided tours, and much more) will deepen the impression of the exhibition. Information at www.mathema-ausstellung.de/en.

Public Tours:

Sunday 15:00 (no additional fee). No reservation required.

Press and Media Assistance

Representatives of the media are invited to download text and image material at www.sdtb.de.

Special pages on the exhibition: www.mathema-ausstellung.de

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