Speech in the Opening of ***Mathematik zum Anfassen***
May 8, 2015, at St. Margaret's Co-educational English Secondary & Primary School

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Thanks to the organizers I have the great pleasure of joining in this opening of the travelling exhibition **"Mathematik zum Anfassen"** in Hong Kong.

You all come for the exhibition rather than for a boring speech by a seventy-year-old retired professor of mathematics, particularly when this professor with absolutely no teaching experience in a school classroom is totally ignorant of how to teach mathematics to kids. Fortunately, this professor was a kid many years ago, and some part of him remains a kid, so he can perhaps still say something from that perspective.

Besides, I have a good German friend who knows a lot about teaching mathematics to kids. Professor Erich Wittmann of Dortmund is a friend and mentor to me. He is one of the co-founders of the project "Mathe 2000" that was begun in 1987 to support teachers in putting into practice a certain new syllabus for mathematics at the primary school level in the State of Nordrhein-Westfalen. Erich often likes to quote a saying from the ancient Chinese philosopher Zhuangzi ( 莊子), " 嬰兒生無石師而能言，與能言者處也 [ Ein kleines Kind, das geboren wird, braucht keinen berühmten Lehrer um sprechen zu lernen. Es lernt das Sprechen von alleine, wenn es mit Leuten zusammen ist, die sprechen. (**When a child is born, it needs no great teacher; nevertheless it learns to talk as it lives with those who talk.**)]"

The original saying conveys the point that one should let things happen naturally without imposing outside force just like a child learns to talk naturally without being taught. Erich borrows it to mean that learning does not come by teaching forced upon the learner but is prompted by the learner's own initiative motivated by a suitably designed environment. The theme of this exhibition, **"Mathematik zum Anfassen (Hand-on Mathematics)"** amply confirms this idea. After interest has been aroused it would do well to lead learners travel further on their mathematical expeditions that go beyond just fun and playfulness.

Let me use the remaining five minutes to share with you a few examples gleaned from my own teaching-learning experience in mathematics (with accompanying slides making use of GeoGebra, thanks to the generous assistance of Mr. OR Chi Ming) .

## (1) Tangram and SOMA Cube

The first piece of toy I have fond memory of from childhood recollection is a **tangram**, which would be familiar to most of us. Obviously it has a rich taste of mathematics. For instance, two sets of tangrams can be used to illustrate a special case of Pythagoras' Theorem. It is an interesting question to find out how many convex polygons can be made from a tangram. Some twenty years later after acquiring a tangram I got hold of a 3-D version of the tangram, the SOMA Cube created by the famous Danish polymath Piet Hein. It has an even richer taste of mathematics.

## (2) Inscribed Circle in a Right Triangle

Interesting examples abounds in history. Let me just show one from the writings of a famous Chinese mathematician by the

name of LIU Hui (劉徽) in the 3rd century. He solved a problem that was raised more than two thousand years ago, namely, to find the diameter of a circle inscribed in a given right triangle. He solved it in a very clever way of cut-and-paste. This is typically a "proof without words".

**(3) Net of a Cube**

The third example is one that happened to occupy me in the past couple of weeks. It is not hard to see that a certain net will fold up to make a cube. There are clearly many ways to do it. Given a configuration of six squares joined up in some manner, can we decide if it is the net of a cube without having to try folding it up? Do we know how many different nets there are and what they look like? This can be turned into an activity for kids, who may learn some mathematics through the game-like activity. My good friend Erich actually carried out this task in the classroom.

**(4) Dragon Curve**

The last example is a very simple exercise of folding up a narrow strip of paper. After folding up the paper a few times, can you predict the pattern of the creases, some inward and some outward? Through this investigation kids may learn something about mathematical reasoning. Besides, by iterating the procedure a large number of times one obtains a fascinating and beautiful pattern called a Dragon Curve, which is an example of a mathematical object studied in modern day mathematics, that of the area of fractal geometry. Who would say that paper folding is only child's play?!

To conclude let me borrow a quote that I like fairly much:

"Gross [Karl Groos] well says that children are young because they play, and not vice versa; and he might have added, men grow old because they stop playing, and not conversely, for **play is, at bottom, growth, and at the top of the intellectual scale it is the eternal type of research from sheer love of truth**."

(From: G. Stanley Hall, *Adolescence: Its Psychology and its Relations to Physiology, Anthropology, Sociology, Sex, Crime, Religion and Education*, 1904.)

I wish the exhibition all success and thanks to the hard work of the organizers which makes this exhibition possible! Thank you!

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