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Let's talk about figures

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Panos

The eternal language of numbers is reborn as a form of communication that people all over the world can use—and, increasingly, must use

BRILLIANCE with numbers is a curious thing. Paul Erdos, a Hungarian who died in 1996, used to travel the world and stop briefly at the offices and homes of fellow mathematicians. “My brain is open,” he would announce as, with uncanny intuition, he suggested a problem that, without realising it, his host was already half-way to solving. Together they would find the solution.

In a discipline-wide joke, grateful mathematicians still use “Erdos numbers” to indicate how close they were to contact with the great man: “Erdos 1” describes his co-authors, “Erdos 2” indicates their co-authors, and so on. And in all seriousness, the fruits of Erdos's 83-year life include more than 1,500 jointly authored publications, and a network that extends via his collaborators not only into most areas of mathematics but into many other fields—physics, biology, linguistics and more.

With his determination to overcome all the difficulties posed by immigration authorities or language (gestures and formulas were enough, if he and his hosts shared little vocabulary), the Hungarian epitomised many things about his subject. More than most other sorts of knowledge, mathematics has always transcended the limits of time and space. The genius of ancient Greek geometry not only stands the test of time (Pythagoras's theorem is as valid now as when it was first proved); its discoveries can suddenly find new applications in the 21st century.

And in an age of e-communications, continent-hopping scholars (not usually as eccentric as Erdos), and journals whose authors and readers come from every corner of the earth, mathematics is coming into its own as a sort of global dialogue in which anybody can take part—and whose fruits are not just beneficial, but indispensable, in just about every area of science.

In years past, people with a gift for numbers often overcame vast odds to find an outlet for their genius. Srinivasa Ramanujan was a humble clerk in British India when, in 1912, he began sending theorems to Cambridge professors. Just one recipient saw the work's value and invited Ramanujan to England.

The internet gives today's Ramanujans a better chance. But in any case, by comparison with the arts, doing well at maths was always much less dependent on cultural or economic factors. A talented number-spinner doesn't need to be nurtured by visits to art galleries or the opera, or access to a parental library. Nor are the rules of algebra governed by social conventions: a gawky 14-year-old who clams up in interviews can still do well.

And pure mathematics, at least, needs no fancy facilities like particle accelerators or wind tunnels. Sometimes a pen and paper is enough. Many a researcher has returned from an international conference with a napkin or beer-mat covered in jottings from a spontaneous and convivial late-night collaboration.

Admittedly, there is less of a distinction these days between pure maths and the applied sort; that is one of the consequences of a world where all sorts of knowledge seem to spread and fuse in unpredictable ways. For example, the kind of theoretical maths that would terrify a layman has become an indispensable key to understanding the way that living things behave. Anything that grows and disseminates—from single-celled organisms to malignant tumours, from rainforests to the pigments that form stripes or spots in the animal kingdom—can be modelled with the latest computational tools. At a time when the volume of data about every form of life is vast and crying out to be processed, “some kinds of pure maths are remarkably useful for biology,” says Philip Maini, a mathematician who divides his time between Oxford, China, Australia and American campuses.

Topology in transit

The sheer mobility of talented mathematicians makes them hard to pin down, in any sense. Earlier this year (in a move comparable to the flight of a bond-trading team from one bank to another), a dozen experts on topology, a branch of geometry, revealed that they had constituted the editorial board of a new journal founded by the London Mathematical Society (LMS), a scholarly body. Previously—before resigning en masse—they had formed the board of a journal on a similar topic produced by Elsevier, a Dutch-based publishing concern. The LMS already owns or co-publishes 11 other weighty journals: less than a fifth of the writers for those august tomes are British.

The world of mathematics is not exactly a market, in the sense of a forum where people always sell to the highest bidder: indeed, one (fully intended) consequence of the topologists' change of affiliation is that work in their field will be available at lower prices to humble scholars. But international maths is a form of marketplace, where all sorts of people trade their intellectual wares to enormous mutual benefit.

In an age where you need to be numerate to do almost anything else (from building bridges to conquering disease), governments anxiously compare their performance in mathematics with that of competitor nations. This month a new cry of alarm came from America, where a National Mathematics Advisory Panel, established by George Bush in 2006, reported that “without substantial and sustained changes” the country was doomed to “relinquish its leadership” in the world of numbers as the century wears on.

America has long masked its difficulty in educating enough mathematicians by importing lots of ready-made talent, especially from East Asia and the former Soviet Union. But the problems are real enough. As the panel noted, the share of American students doing degrees in maths or related areas fell from 32% in 1994-95 to 27% in 2003-04. And the share of maths-related doctorates at American universities that went to American citizens or residents fell over the past four decades from 80% of the total to less than 60%. The panel concluded that America's problems become apparent when students start to study algebra—for most, their first encounter with genuinely abstract thinking.

For really high-flying mathematicians, the very idea of a national maths culture sounds dated. It comes naturally to them to find collaborators in one continent, publish in another and teach all over the world. But governments cannot help worrying; and the trick of importing fully-trained brains will become less

viable as “exporting” countries develop their own systems of higher learning.

Among the communist or ex-communist countries whose brightest sons and daughters have often found their way to America, Canada or Australia, there are some interesting differences. As Ari Laptev, the (Soviet-born) president of the European Mathematical Society, points out, Tsarist Russia had a fine maths culture, and even in the darkest Soviet days, pure maths was an island of excellence and integrity. In the post-communist slump, Soviet mathematicians emigrated in droves, leaving a lack of mentors for today's brainy kids. But in the new mood of nationalism and oil wealth, the mathematicians who stayed in Moscow are walking taller. Their challenge is how to keep youngsters in academia when they could be making money.

In China, the cultural revolution hurt maths more than Russia's Bolsheviks ever did; but these days, Chinese teenagers do superbly in global maths contests, and most of the Chinese doctoral students who people the maths faculties of the world will probably bring their talents home. Opportunities are expanding in China and narrowing elsewhere. China's output of original mathematical work is still mediocre, but it is improving rapidly. New Chinese journals are being started; inventive minds will soon be filling them.

In any case, it may be time to rethink the very idea of national teaching systems that with varying success prepare youngsters to join a global conversation when they grow up. Already, some of the solutions to school-teaching challenges are as global as could be. Take HeyMath!—an interactive maths-education package co-designed by Britain's Cambridge University and some bankers in the south Indian city of Chennai: it has served 250,000 children in 33 countries; 2,000 teachers are using it now. Having gained an American foothold in Massachusetts, HeyMath! programmes honed in India (with help from partners in Singapore) are now being tried out by three schools in Connecticut. If only Ramanujan were alive to see it.