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COGITO, ERGO *SUMMER*

BY SIOBHAN ROBERTS

These steamy months, now coming to an end, provide a hothouse for the idylls of scientific research.

ILLUSTRATION BY KEITH NEGLEY

Patrick Honner, a math teacher at Brooklyn Technical High School, arrived at a recent class seemingly unprepared. This was surprising, given that, days before, he had received a Presidential Award for Excellence in Mathematics and Science Teaching. The class was a special summer session at the Museum of Mathematics, in Manhattan, a part of the second MOVES conference—Mathematics of Various Entertaining Subjects, this year featuring the classic book "Winning Ways for Your Mathematical Plays," by the game-theorist trio Elwyn Berlekamp, John Horton Conway, and Richard Guy. "I have some ideas about what we're going to do today, but I don't have a complete idea," Honner told his forty students, who ranged in age from about ten to six times ten. "I'm hoping we can play around, and you can invent your own games and go off and explore."

As the students paired off and played around with pennies and nickels on polygonal graphs—the object being to get more of one's currency covering the vertices and observe what winning strategies emerge—it became apparent that Honner's unpreparedness was planned. And, indeed, mathematicians and scientists of all permutations have taken roughly the same carefree and exploratory approach to their summers for generations. Three hundred and seventy-eight years ago, in June, 1637, René Descartes published his "Discourse on the Method," the treatise that, among other things, coined the phrase "*Je pense, donc je suis*," later Latinized as "*Cogito, ergo sum*." That last word might as well be "summer." Isaac Newton read "La Géométrie," an appendix to the "Discourse," the summer after he turned twenty-one, and according to the late D. T. Whiteside, a Newton authority at Cambridge, the "thick wad" of surviving papers from later that year suggest it was then that Newton's "mathematical spirit took fire." Similarly, Albert Einstein wrote his inaugural physics essay, "On the Investigation of the State of the Ether in a Magnetic Field," in the summer of his sixteenth year. Four summers later, in 1899, he wrote to his classmate Mileva Marić (later his wife), "I had a good idea for investigating the way in which a body's relative motion with respect to the luminiferous ether affects the velocity of the propagation of light in transparent bodies."

In short, these steamy months, now coming to an end, provide a hothouse for the idylls of research. Free from the demands of teaching and admin, summer is playtime, a season to congregate for fun and fellowship and a time to get down to serious work, whether with trivial recreational nerdish delights or full-on hard-core research projects. (Those two things being, for some people, interchangeable.) And so it happened that, earlier this summer, while the game theorists were at the Museum of Mathematics, the probability theorists went to Israel, the knot theorists to Turkey, the algebraic-group theorists to France, the logicians to Ireland and Finland, the optimization scientists to Azerbaijan, the topologists to China, and the geometers to Macedonia. Those seeking the foundational and computational aspects of the higher infinite went to England, as did those exploring "New Moonshines, Mock Modular Forms, and String Theory (http://www.maths.dur.ac.uk/events/Meetings/LMS/2015/MMS15/)," and the International Puzzle Party went down in Ottawa, Canada (invitation only, alas).

That these enthusiasts spend their vacations working—rather than, say, subjecting brisket to the rigors of the scientific method—is symbolic at once of their enthusiasm for curiosity-driven research and of the threat to its existence. In April, at the first annual National Math Festival, in Washington, D.C., the mathematician and biologist Eric Lander, who is the co-chair of President Obama's Council of Advisers on Science and Technology, lamented that research budgets around the world are increasingly dictated by getting "maximum bang for the buck" in the short term. This can deprive more esoteric projects of the chance to grow and, perhaps, yield astonishing results. "Transformative ideas and discoveries often come out of left field," Lander said. "I've started to call this thing the miracle machine. It is miraculous, and it is a machine, because it's quite reproducible; it works again and again." Number theory, for instance, one of the more arcane branches of mathematics, unexpectedly shows great utility in cryptography (http://www.newyorker.com/tech/elements/pi-prime-numbers-cybersecurity), making it "central to commerce and defense," Lander said. In order for the machine to work, though, the powers that be must have as much all-seasons faith in scientists as scientists display passion in the summertime.

In Baltimore this summer, the eighteenth annual Bridges Conference convened to display some of the fruits of unabashed curiosity. Bridges began in 1998, in Winfield, Kansas, and in the intervening summers it has drawn hundreds of artistically minded mathematicians and scientists to Spain, England, the Netherlands, Hungary, Portugal, and Korea, for no applied purpose other than freewheeling investigation and inspiration and show-and-tell. This year, Carlo Séquin, a pioneer in computer-processor design and a professor at the University of California, Berkeley, exhibited a sunshine-yellow loop-de-looping sculpture. "This is really just a warped tetrahedral frame made from broad, curved ribbons," he said. Séquin sees a yin-yang dynamic between his work and his art. "It's solidly intertwined," he said. Meanwhile, David Reimann, a professor of mathematics and computer science at Albion College, in Michigan, showed off his bespoke polyhedra. One fetching specimen—an Archimedean solid known as the small

rhombicosidodecahedron—he had fashioned from two hundred and forty condoms (still in their wrappers). “I happened to have a lot of them lying around,” Reimann said. He named his creation “Inconceivable Symmetries.”

That title also nicely encapsulates the happenstance of research and play unfolding these long summer days. There’s no way of knowing when an idea will coalesce and the stars align, producing a discovery that solves a crucial problem, creates a windfall of googol dimensions, or triggers a smile.

Watch: Alec Wilkinson explains a mathematical breakthrough.

Siobhan Roberts is a science writer based in Toronto. Her book “Genius at Play,” about the Princeton mathematician John Horton Conway, came out in July.