MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

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Methodological guidelines
for individual work
on the subject

"THEORY AND PRACTICE OF TRANSLATION (ENGLISH LANGUAGE)"

(for the 2nd year full-time students specializing in 035 – Philology)

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UNIT 1

CHALLENGES OF SCIENTIFIC AND TECHNICAL TRANSLATION

Translate the text into Ukrainian identifying translation difficulties and trying to solve them in the most appropriate way:

First, the authors found a way to produce charge puddles directly in silicon by randomly implanting atoms that donate small amounts of charge to the silicon itself. This method makes the devices more broadly manufacturable than they previously were and potentially compatible with the current generation of electronics, which are also mainly based on silicon. Second, in this new material system, the maximum temperatures at which hopping dominates the electrical flow in these circuits, and therefore at which the desired operation is viable, is increased from barely above absolute zero to room temperature.

To demonstrate the increased potential of these devices, Chen *et al.* evolved circuits that could classify all 16 possible sets of 4 binary inputs (0000, 0001, …, 1111, where 0 represents no input on a given wire and 1 represents an input on a given wire). This classification was possible even when the number of control voltages was reduced from five to three.

The authors then incorporated this *in silico* 4-input classifier into the more complex AI task of classifying a standard set of black and white images of handwritten digits, which were encoded as a 28×28 array of pixels, each with a value of either 0 (white) or 1 (black) (see Fig. 4 of the paper[3]). To do this, Chen *et al.* subdivided the original array into sets of 2×2 neighbouring pixels and fed the value of each of these 4 pixels into the 4-input classifier's input wires. The authors then set the control wires to perform classification for each of the 16 possible sets of 4 inputs, and passed all 16 outputs for each set of 2×2 pixels to a machine-learning algorithm run on conventional hardware that identified the digit in the full image.

UNIT 2

TRANSLATION OF PREDICATE: TENSES OF THE VERB

Translate the text into Ukrainian focusing on the tenses of the verb:

Although computers excel at performing calculations that have well-defined answers, they have not been good at making guesses. For example, if you are thinking about selling your car, a computer is ideally suited for calculating the average price that similar cars have sold for, to help you determine your selling price. But by analysing the enormous digital data sets that are currently available, AI techniques such as machine learning can now teach computers to make sensible predictions. One of the most basic operations that machine-learning algorithms can

carry out when provided with a large set of inputs (such as the age of a car and how many kilometres it has been driven) is classification into one of a set of categories, such as whether the car is in poor, fair or good condition and therefore whether you can expect to get the price you want for it.

Using the structure of the human brain as inspiration, scientists and engineers have made substantial progress in developing specialized hardware to greatly reduce the amount of time and energy needed to perform tasks such as classification. There are also many unconventional device concepts for machine learning that are still in the early stages of development but that could offer radical new capabilities. For example, researchers are exploring whether superconductor-based electrical circuits that work at only a few degrees above absolute zero, and that operate at gigahertz frequencies with high energy efficiency, could enable machine-learning applications that are currently infeasible using conventional approaches.

UNIT 3

TRANSLATION OF PREDICATE: SEQUENCE OF TENSES

Translate the text into Ukrainian focusing on the correct translation of sequence of tenses:

Elements of what became physics were drawn primarily from the fields of astronomy, optics, and mechanics, which were methodologically united through the study of geometry. These mathematical disciplines began in antiquity with the Babylonians and with Hellenistic writers such as Archimedes and Ptolemy. Ancient philosophy, meanwhile – including what was called "physics" – focused on explaining nature through ideas such as Aristotle's four types of "cause".

The move towards a rational understanding of nature began at least since the Archaic period in Greece (650–480 BC) with the Pre-Socratic philosophers. The philosopher Thales of Miletus (7th and 6th centuries BC), dubbed "the Father of Science" for refusing to accept various supernatural, religious or mythological explanations for natural phenomena, proclaimed that every event had a natural cause. Thales also made advancements in 580 BCE by suggesting that water is the basic element, experimenting with the attraction between magnets and rubbed amber and formulating the first recorded cosmologies.

Hipparchus (190–120 BC), focusing on astronomy and mathematics, used sophisticated geometrical techniques to map the motion of the stars and planets, even predicting the times that Solar eclipses would happen.

UNIT 4
TRANSLATION OF PREDICATE: VOICES OF THE VERB

Translate the text into Ukrainian focusing on the correct translation of the passive voice:

A scheme that can be used for producing single photons from single electrons was proposed by Foden et al. It was originally proposed for making a SAW-driven single-photon source with a high repetition rate. This makes use of the fact that, in a piezoelectric material such as GaAs, a SAW consists of both a strain and a potential modulation. In a narrow channel, electrons are confined in moving quantum dots formed by the SAW potential and the lateral channel potential. The number, n, of electrons in each SAW potential minimum is well defined if the Coulomb charging energy is large enough. The SAW (of frequency f_{SAW}) can therefore drive a quantised current nef_{SAW} along the channel (e is the electronic charge). To generate photon emission, single electrons must be carried in SAW potential minima across a lateral n-i-p junction to create single photons by recombining with holes (see Supplementary Movie 1 for a schematic animation). Using this scheme, a propagating single-electron state is converted to a single-photon state.

To demonstrate the electron-to-photon conversion in the single-electron limit, the second-order correlation function, $g^{(2)}(0)$, where $g^{(2)}(0) \leq 1$ for sub-Poissonian light and $g^{(2)}(0) \leq 0.5$ for single-photon emission, needs to be measured when the SAW-driven current $\sim 1 ef_{SAW}$. For two decades, various attempts have been made to implement this scheme but single-photon emission has not been observed. Our recent work shows quantised SAW-driven current in a gate-induced n-i-n junction, indicating a promising route for an electron-to-photon interface using gate-induced n-i-p junction.

We note that several works based on SAW-injected excitons into a self-assembled quantum dot or a SAW-modulated Purcell effect in a dot-cavity system have shown single-photon emission. Long-distance transport of optically excited carriers along an etched quantum wire is also achieved using a SAW.

UNIT 5

TRANSLATION OF PREDICATE: INVERTED PREDICATE

Translate the text into Ukrainian focusing on the correct translation of inverted predicate:

Still, a clear connection between the success of individuals and their role in the music scenes' social fabric is lacking. Here we aim to fill this gap by investigating the well-defined ecosystem of artists working on electronic music. During the past two decades, electronic music transitioned from the outskirts of

music to become one of its most popular fields. Yet, strange as it may seem, electronic music has only produced a handful of stars typically performing in front of tens of thousands of people, while the majority of disc jockeys (DJs) and producers remain unknown. Hence, our goal is to better understand how superstar DJs and producers (since a large fraction of DJs also act as producers) emerge by analyzing the interplay between individual success, quantified in terms of the top 100 DJs' ranking list from 1997 to 2018 (curated by DJ Magazine), and the underlying collaborations captured based on Discogs. Also detected is the structure and the dynamics of the various communities in the artists' co-release network and trace the effects of mentorship on early-career musicians. In fact, mentorship is usually the door through which new talents enter social environments whose activity is based on skills that require long traineeships, and its effect has already been tracked within academia. In addition to revealing certain characteristics of success in electronic music (such as the typical trajectory of a successful DJ), our work provides a foundation to approach more intricate phenomena in the world of electronic music. Examples are the way unknown DJs enter the top 100 (from a large repository of amateur artists), as well as the strikingly large gender gap observed in the underlying dynamics of music development.

UNIT 6

TRANSLATION OF SUBJECT: FORMAL SUBJECT *THERE*

Translate the text into Ukrainian focusing on the correct translation of the formal subject *there*:

Many people are familiar with divisibility tests for 3 and 9: if the (base ten) digits of a number add up to a multiple of 3, the number is divisible by 3. If they add up to a multiple of 9, the number is a multiple of 9. There are also easy ways to tell whether a number is divisible by 2 or 5 or 11. But you probably didn't learn a divisibility test for 7. (There is one, but it's not as easy to use as the rules for 3 and 9).

The proof for divisibility by 9 uses modular arithmetic, where you only look at the remainders of numbers when divided by another number. It is also called clock arithmetic because we use arithmetic mod 12 when we tell time. (Five hours after 10:00 is 3:00 because $10 + 5 = 3$ mod 12). The proof that numbers are divisible by 9 if their digits sum to a multiple of 9 uses the fact that 10, the base of the decimal number system, is 1 mod 9. Divisibility rules use modular arithmetic because the basic question is: does this number have a remainder of 0 when divided by another number?

This rule for 7 does not scale up as well as the rules for 3 and 9. The powers of 3 you need to compute for the 7 rule get unwieldy. Using this rule for a number that has 10 digits would require multiplying the leftmost digit by 59,049.

(An exercise for the interested reader: figure out how to adapt this rule to be a little more practical by taking advantage of the cyclic nature of powers of 3 mod 7). But even though the rule is not terribly useful, aBa told us that figuring out this theorem and its proof changed his life. He created something new in mathematics for the first time, and he was hooked.

UNIT 7

TRANSLATION OF SUBJECT: INDEFINITE PRONOUN *ONE*

Translate the text into Ukrainian focusing on the correct translation of the indefinite pronoun *one*:

One can hardly disagree that excessive application of chemical fertilizer has exerted a great threat to soil quality and the environment. The inoculation of plants with plant-growth-promoting rhizobacteria (PGPR) has emerged as a great prospect for ecosystem recovery. The aim of this work to isolate PGPRs and highlights the effect of bacterial inoculants on available N/P/K content in soil and on the growth of wheat under conditions of reduced fertilizer application.

Thirty-nine PGPRs were isolated and tested for their growth-promoting potential. Thirteen isolates had nitrogen fixation ability, of which N9 (*Azotobacter chroococcum*) had the highest acetylene reduction activity of 156.26 nmol/gh. Eleven isolates had efficient phosphate solubilizing ability, of which P5 (*Klebsiella variicola*) released the most available phosphorus in liquid medium (231.68 mg/L). Fifteen isolates had efficient potassium solubilizing ability, of which K13 (*Rhizobium larrymoorei*) released the most available potassium in liquid medium (224.66 mg/L). In culture medium supplemented with tryptophan, P9 (*Klebsiella pneumoniae*) produced the greatest amount of IAA. Inoculation with the bacterial combination K14 + 176 + P9 + N8 + P5 increased the alkali-hydrolysed nitrogen, available phosphorus and available potassium in the soil by 49.46, 99.51 and 19.38 %, respectively, and enhanced the N, P, and K content of wheat by 97.7, 96.4 and 42.1 %, respectively. Moreover, reducing fertilizer application by 25 % did not decrease the available nitrogen, phosphorus, and potassium in the soil and N/P/K content, plant height, and dry weight of wheat.

Thus, one can clearly claim that the bacterial combination K14 + 176 + P9 + N8 + P5 is superior candidates for biofertilizers that may reduce chemical fertilizer application without influencing the normal growth of wheat.

UNIT 8

TRANSLATION OF SUBJECT: PRONOUN *IT*

Translate the text into Ukrainian focusing on the correct translation of pronoun *it*:

Klebsiella pneumoniae is considered the most clinically relevant species of Enterobacteriaceae, known to cause severe infections including liver abscesses. To the best of our knowledge, a large proportion of iron in the human body is accumulated and stored in the liver. It is hypothesized here that increased iron availability is an important factor driving liver abscess formation and we therefore aim to understand the effects of iron on *K. pneumoniae* causing liver abscesses.

All tested *K. pneumoniae* clinical isolates, including those isolated from liver abscesses and other abdominal invasive infection sites, grew optimally when cultured in LB broth supplemented with 50 μM iron and exhibited the strongest biofilm formation ability under those conditions. Decreased growth and biofilm formation ability were observed in all tested strains when cultured with an iron chelator ($P < 0.05$). The infection model of *G. mellonella* larvae indicated the virulence of liver abscess-causing *K. pneumoniae* (2/3) cultured in LB broth with additional iron was significantly higher than those under iron-restricted conditions ($P < 0.05$). The relative expression levels of the four siderophore genes (*iucB*, *iroB*, *irp1*, *entB*) in *K. pneumoniae* strains isolated from liver abscesses cultured with additional iron were lower than those under iron-restricted conditions ($P < 0.05$).

It is suggested by our research that iron in the environment can promote growth, biofilm formation and enhance virulence of *K. pneumoniae* causing liver abscesses. It is shown to be the case that a lower expression of siderophore genes correlates with increased virulence of liver abscess-causing *K. pneumoniae*. Further deeper evaluation of these phenomena is warranted.

UNIT 9

TRANSLATION OF SUBJECT: GERUND

Translate the text into Ukrainian focusing on the correct translation of *Gerund* in the position of a subject:

Creating, developing and then incorporating innovative cellular communications technologies in standards is a massive endeavor that expands significantly as it proceeds. It involves increasing numbers of companies as it progresses from conception through to the adoption of new technologies in Technical Specifications at 3GPP and in the standards with its seven regional partners, most significantly including the European Telecommunications Standards Institute (ETSI). Any assessment of how much value is contributed and by whom to standard-essential technologies, including 3G WCDMA or HSDPA, 4G LTE and

5G cellular, must consider the entire process including Stages 1 and 2, not only what is most visible and measurable in standard-setting activities, such as contributions or meeting attendance, at Stage 3.

The large R&D investments and resulting value generated in the first and second stages of innovation, identified above, are not always apparent because the work there is largely hidden from the public or might only be recognized by specialists. In contrast, the popular but simplistic use of publicly-available SSO activity metrics in Stage 3, such as counting the numbers of technical contributions to 3GPP Working Groups (WGs) as a proxy for a company's share of innovation in standards, can significantly understate the value provided by inventors and pioneers while inflating that of companies who join the bandwagon of an emerging success later on - for example, in the Study Item (SI) and Work Item (WI) phases of standard setting at 3GPP.

Most of the activities logged in the public records of 3GPP are the mere tip of the iceberg in terms of the total amount of development work undertaken, including that outside this SSO, with even more extensive other activities submerged from public view. Activities including in WGs and other meetings at 3GPP are publicly visible because "TDoc" technical contribution documents, meeting attendance records and other information are all available publicly online. But this represents only a small proportion of total effort and rather less still of technical effort or innovation, which most significantly also includes company R&D outside this SSO.

UNIT 10

TRANSLATION OF SUBJECT: INFINITIVE

Translate the text into Ukrainian focusing on the correct translation of *infinitive*:

The first "atoms" in the universe were not atoms at all–they were just nuclei that had not found electrons yet. The simplest nucleus, that of common hydrogen, is a bare proton with no frills. When the universe banged into existence, energy was rampant. Everything was smashing into everything else. Protons and neutrons often collided, and some formed larger nuclei, such as that of deuterium (containing a proton and a neutron), as well as helium nuclei with two protons and two neutrons. Various other arrangements of protons and neutrons also formed, but because the identity of an atom is determined by its number of protons, all these other conglomerations were basically just different versions of hydrogen, helium and traces of lithium.

Of these three, helium was the first to begin forming "real" atoms. An atom is more than a nucleus – it must also possess electrons. Helium nuclei were the first to gather a full purse of electrons en masse. Why not hydrogen or lithium? Well, helium is the first "noble gas" on the periodic table – the first atom with enough electrons to completely fill the available slots in its electron shell. Thus, it seems reasonable

to assume that if electrons are the currency of chemistry, helium is the master pilferer of the periodic table. In a modern laboratory, it takes more energy to steal an electron from helium than from any other element. And the energy required to remove a second electron is more than twice what it takes for the first. In the early universe, once helium nuclei began to find electrons, they filled the coffers of their electron clouds well before the hydrogen nuclei could begin to catch up and before enough lithium nuclei were even present to collect all three of their desired electrons.

UNIT 11

TRANSLATION OF SUBJECT: UNANIMATED AGENTIVE SUBJECT

Translate the text into Ukrainian focusing on the correct translation of unanimated agentive subject*:*

Human hair tested stronger than thicker fibers from elephants, boars and giraffes, providing clues to materials scientists hoping to make superstrong synthetic fibers.

"Normally, when the animal is larger, the hair tends to be thicker," suggested materials scientist Wen Yang from the University of California, San Diego. She's interested in how biological structures like hair hold up under stress. That interest comes from a desire to design better synthetic materials.

Yang's team took a closer look at the hair with a scanning electron microscope. All hair is made of the protein keratin. The microscope views revealed specific patterns of breakage in the keratin fibers, which are composed of a protective outer cuticle and an inner cortex that provides strength.

The microscope images showed that the cortex of thicker hair tends to snap when broken, leaving a clean, even break. But the inner cortex of thinner hair breaks off less evenly. Yang compares the process to what happens when a powerful gust of wind blows a tree down. In those cases, the trunk tends to shear at an angle. And that kind of break is a sign of strength–it actually takes more tension to cause shearing than a clean break.

UNIT 12

TRANSLATION OF SUBJECT: SUBJECT-PREDICATE INFINITIVE CONSTRUCTION

Translate the text into Ukrainian focusing on the correct translation of subject-predicate infinitive construction*:*

Last month, SpaceX became the operator of the world's largest active satellite constellation. As of the end of January, the company had 242 satellites orbiting the planet with plans to launch 42,000 over the next decade. This is part of its ambitious project to provide internet access across the globe. The race to put satellites in space

is on, with Amazon, U.K.-based OneWeb and other companies chomping at the bit to place thousands of satellites in orbit in the coming months.

These new satellites have the potential to revolutionize many aspects of everyday life–from bringing internet access to remote corners of the globe to monitoring the environment and improving global navigation systems. Amid all the fanfare, a critical danger has flown under the radar: the lack of cybersecurity standards and regulations for commercial satellites, in the U.S. and internationally. As a scholar who studies cyber conflict, I'm keenly aware that this, coupled with satellites' complex supply chains and layers of stakeholders, leaves them highly vulnerable to cyberattacks. A rough idea of what is thought to be of a very high probability is given below.

If hackers were to take control of these satellites, the consequences are believed to be dire. On the mundane end of scale, hackers could simply shut satellites down, denying access to their services. Hackers could also jam or spoof the signals from satellites, creating havoc for critical infrastructure. This includes electric grids, water networks and transportation systems.

Some of these new satellites have thrusters that allow them to speed up, slow down and change direction in space. If hackers took control of these steerable satellites, the consequences could be catastrophic. Hackers could alter the satellites' orbits and crash them into other satellites or even the International Space Station.

Makers of these satellites, particularly small CubeSats, use off-the-shelf technology to keep costs low. The wide availability of these components means hackers can analyze them for vulnerabilities. In addition, many of the components draw on open-source technology. The danger here is that hackers could insert back doors and other vulnerabilities into satellites' software.

Satellites are typically controlled from ground stations. These stations run computers with software vulnerabilities that can be exploited by hackers. If hackers were to infiltrate these computers, they could send malicious commands to the satellites.

UNIT 13

TRANSLATION OF OBJECT: FORMAL OBJECT *IT*

Translate the text into Ukrainian focusing on the correct translation of formal object *it:*

But by themselves, equations are not explanations, and neither are their solutions. There is a second, nontechnical level of analysis that is intended to provide us with a physical, commonsense explanation of lift. The objective of the nontechnical approach is to give us an intuitive understanding of the actual forces and factors that are at work in holding an airplane aloft. This approach exists not on

the level of numbers and equations but rather on the level of concepts and principles that are familiar and intelligible to nonspecialists.

It is on this second, nontechnical level where the controversies lie. Two different theories are commonly proposed to explain lift, and advocates on both sides argue their viewpoints in articles, in books and online. The problem is that each of these two nontechnical theories is correct in itself. But neither produces a complete explanation of lift, one that provides a full accounting of all the basic forces, factors and physical conditions governing aerodynamic lift, with no issues left dangling, unexplained or unknown.

The other theory of lift is based on Newton's third law of motion, the principle of action and reaction. It states that a wing keeps an airplane up by pushing the air down. Air has mass, and from Newton's third law it follows that the wing's downward push results in an equal and opposite push back upward, which is lift. The Newtonian account applies to wings of any shape, curved or flat, symmetrical or not. It holds for aircraft flying inverted or right-side up.

UNIT 14

TRANSLATION OF OBJECT: INFINITIVE

Translate the text into Ukrainian focusing on the correct translation of infinitive in an object position:

I played with the algorithm a few times and started to understand why it always produced the correct answer. Squaring a number doubles the exponent, and for the base 2, adding one to the exponent corresponds to doubling the number. This method uses fewer steps than simple repeated doubling does, and I found it oddly satisfying to play with.
Piṅgala recorded this algorithm in service of literature. In Sanskrit, a syllable can be either heavy or light, and he was determining the number of possible combinations of heavy and light syllables that could exist in a meter with n syllables. (Not all of these meters were actually used in literature, so the question was one of theory, not literary practice.) His text includes other computations related to counting meters with certain numbers of heavy or light syllables.
Once interpreted, Piṅgala's algorithm was satisfying to me, but his instructions seem cryptic at best in their original form. I saw it as a reminder that mathematics cannot be fully interpreted in complete isolation from the rest of the culture that produces it. To understand why Piṅgala's algorithm takes the form it does, one must know about Sanskrit language, grammar, and aesthetics as well as the history of later scholars producing commentaries on classical texts.

UNIT 15

TRANSLATION OF OBJECT: OBJECT-PREDICATE INFINITIVE CONSTRUCTION

Translate the text into Ukrainian focusing on the correct translation of object-predicate infinitive construction:

Paradigm-shifting discoveries are few and far between. But neuroscientist Carla Shatz has made several. Shatz, a professor of biology and neurobiology at Stanford University, has spent her career exploring how the brain develops and learns. Her journey began with vision. In adults, precisely arranged columns of neurons convey visual information from the eyes to the brain. These visual circuits take shape from the jumble of cells in the early fetal brain some time before a baby is born.

Biologists had believed only hard-wired genetic programming to be able to sculpt such precise circuitry before birth. Shatz instead found that the fetal eye sends test patterns to the brain that tune up the visual circuits before vision is even possible.

The finding was so surprising that many biologists didn't believe it. But it turned out that this sort of circuit testing happens throughout the brain very early in development. These findings revealed how the brain lays the foundation for a lifetime of learning.

As Shatz investigated these early test patterns, she revealed key molecules that sculpt neural circuits. This won over skeptics, and also proved something that scientists had long suspected: that activity strengthens the connections between neurons. Meanwhile, inactive connections are removed by a process called synaptic pruning. These observations shaped today's understanding of neuroplasticity, changes in brain structure and organization that occur as we learn, adapt and think. They also led Shatz to coin the phrase, "Cells that fire together, wire together"– a maxim that guides modern neuroscience.

In 2016, Shatz and Professors Eve Marder at Brandeis University and Michael Merzenich at University of California, San Francisco, were awarded the Kavli Prize in Neuroscience for uncovering how experience and neural activity reshape brain circuits. Now, Shatz outlines the next big questions about neuroplasticity, and how solving them could help treat Alzheimer's disease, make the adult brain more youthful, and uncover how brain cells and circuits create consciousness. Though one cannot expect a complicated problem like that to be solved in a year or so, this still gives hope to many patients.

UNIT 16

TRANSLATION OF OBJECT: PARTICIPLE II OBJECT-PREDICATE CONSTRUCTION

Translate the text into Ukrainian focusing on the correct translation of participle II object-predicate construction:

The M.I.T. team's work would not have been possible without the color-changing photonic fibers that were originally developed back in 2013. Such photonic fibers have a coating made from a periodic arrangement of two different types of elastic rubber, each with different material properties affecting their interaction with light. As a photonic fiber stretches under strain, its original color changes because the coating gets thinner and alters the original optical properties. Such fibers are examples of the same principle behind the rainbow of colors found in soap bubbles, butterflies and beetles.

"If, for instance, a relaxed fiber is red, it will change color through orange, yellow, green and blue to purple as it is stretched more and more," says Mathias Kolle, a mechanical engineer at M.I.T. and a co-author of the study. "In addition, we can tailor the spectral landscape of the fibers and play different tricks to generate other color progressions."

Promising though they may be, such methods are not without limitations. The flat-knot diagrams seem to do well in modeling real-world knot behavior so far, but more complex tangles may require 3-D modeling to fully account for how all the different forces are interacting. "This raises the very fascinating question of generalizing these models into full three-dimensional reality," Kauffman says.

UNIT 17

TRANSLATION OF OBJECT: GERUND

Translate the text into Ukrainian focusing on the correct translation of gerund in an object position*:*

The mathematical theory of knots has typically focused on classifying their different entangled structures without accounting for mechanical stress and strain. To better predict knots' strength, Massachusetts Institute of Technology researchers experimented with those made from special photonic fibers that change color as they stretch. Doing so allowed the team to compare the mechanical-strain predictions of their mathematical models against those of the color-changing fiber experiments and therefore develop more sophisticated models that can simulate the intricacies of knots and, perhaps, more complex tangled structures.

Such work allowed Dunkel and his colleagues to come up with three counting rules for predicting knot stability, as detailed in their study, published in the January 3, 2020, issue of the journal *Science*. They focused on analyzing the strength of different "bend" knots commonly used by sailors and climbers to tie two pieces of rope together.

The first rule suggests that knots gain stability when the two strands have a higher number of crossing points where they come in contact. The second one is that knots become more stable if strand segments at neighboring crossing points rotate in different directions and create opposing friction. And the third rule is that knots gain stability when strands slide tangentially against each other to create friction while being pulled in opposite directions.

UNIT 18

TRANSLATION OF SENTENCE DETERMINANTS: ADVERBS ENDING IN -LY

**Translate the text into Ukrainian focusing on the correct translation of adverbs ending in -ly*:*

Although the origins of inequality are hotly debated, an approach developed by physicists and mathematicians, including my group at Tufts University, suggests they have long been hiding in plain sight–in a well-known quirk of arithmetic. This method uses models of wealth distribution collectively known as agent-based, which begin with an individual transaction between two "agents" or actors, each trying to optimize his or her own financial outcome. Reputedly, in the modern world, nothing could be more fair or natural than two people deciding to exchange goods, agreeing on a price and shaking hands. Indeed, the seeming stability of an economic system arising from this balance of supply and demand among individual actors is regarded as a pinnacle of Enlightenment thinking–to the extent that many people have come to conflate the free market with the notion of freedom itself. Our deceptively simple mathematical models, which are based on voluntary transactions, suggest, however, that it is time for a serious reexamination of this idea.

Strictly, the affine wealth model (called thus because of its mathematical properties) can describe wealth distribution among households in diverse developed countries with exquisite precision while revealing a subtle asymmetry that tends to concentrate wealth. We believe that this purely analytical approach, which resembles an x-ray in that it is used not so much to represent the messiness of the real world as to strip it away and reveal the underlying skeleton, provides deep insight into the forces acting to increase poverty and inequality today.

UNIT 19

TRANSLATION OF SENTENCE DETERMINANTS: INFINITIVE METATEXT CLAUSES

**Translate the text into Ukrainian focusing on the correct translation of infinitive metatext clauses*:*

Most of us learn some amount of Euclidean geometry in school. We learn that the interior angles of triangles add up to 180°. We learn how to prove that lines are parallel, or shapes are congruent or similar. Even though we live on a planet that is not flat, our everyday intuition is on a scale that makes us feel like Euclidean geometry is the natural way to think about shapes, lengths, and angles.

I think it's a real shame that more students are not exposed to non-Euclidean geometry early in their educations, but that's a column for another time. Suffice it to say that if one is lucky enough to encounter geometry beyond that which takes place on a perfectly flat plane, one will learn that there is much more to geometry than two-column proofs and the Pythagorean theorem.

To make matters worse, the intuition we develop in Euclidean geometry does not prepare us well for non-Euclidean geometry. One of the delights I found when I first started studying hyperbolic geometry (one of the flavors of non-Euclidean geometry) was that many things that seem so obvious as not to require any kind of justification are flat-out wrong when we leave the flat Euclidean plane. To illustrate, let us take the following case.

UNIT 20

TRANSLATION OF ADVERBIAL MODIFIERS: ADVERBS ENDING IN -LY

Translate the text into Ukrainian focusing on the correct translation of adverbs ending in -ly in a position of an adverbial modifier:

The plasma-surface interaction is studied for a low temperature helium plasma jet generated at atmospheric pressure using Mueller polarimetry on an electro-optic target. The influence of the AC kHz operating frequency is examined by simultaneously obtaining images of the induced electric field and temperature of the target. The technique offers high sensitivity in the determination of the temperature variation on the level of single degrees. Simultaneously, the evolution of the electric field in the target caused by plasma-driven charge accumulation can be measured with the threshold of the order of 10^5 V/m. Even though a specific electro-optic crystal is used to obtain the results, they are generally applicable to dielectric targets under exposure of a plasma jet when they are of 0.5 mm thickness, have a dielectric constant greater than 4 and are at floating potential. Other techniques to examine the induced electric field in a target do not exist to the best of our knowledge, making

this technique unique and necessary. The influence of the AC kHz operating frequency is important because many plasma jet designs used throughout the world operate at different frequency which changes the time between the ionization waves and hence the leftover species densities and stability of the plasma. Results for our jet show a linear operating regime between 20 and 50 kHz where the ionization waves are stable and the temperature increases linearly by 25 K. The charge deposition and induced electric fields do not increase significantly but the surface area does increase due to an extended surface propagation. Additionally, temperature mapping using a $100\,\mu$m GaAs probe of the plasma plume area has revealed a mild heat exchange causing a heating of several degrees of the helium core while the surrounding air slightly cools. This peculiarity is also observed without plasma in the gas plume.

UNIT 21

TRANSLATION OF ADVERBIAL MODIFIERS: PARTICIPLE I

Translate the text into Ukrainian focusing on the correct translation of Participle I:

While electrons moving perpendicular to a magnetic field are confined to cyclotron orbits, they can move freely parallel to the field. This simple fact leads to complex current flow in clean, low carrier density semi-metals, such as long-ranged current jets forming along the magnetic field when currents pass through point-like constrictions. Occurring accidentally at imperfect current injection contacts, the phenomenon of "current jetting" plagues the research of longitudinal magneto-resistance, which is particularly important in topological conductors. Here we demonstrate the controlled generation of tightly focused electron beams in a new class of micro-devices machined from crystals of the Dirac semi-metal Cd_3As_2. The current beams can be guided by tilting a magnetic field and their range tuned by the field strength. Finite element simulations quantitatively capture the voltage induced at faraway contacts when the beams are steered towards them, supporting the picture of controlled electron jets. These experiments demonstrate direct control over the highly non-local signal propagation unique to 3D semi-metals in the current jetting regime, and may lead to applications akin to electron optics in free space.

UNIT 22

TRANSLATION OF ADVERBIAL MODIFIERS: PARTICIPLE II

Translate the text into Ukrainian focusing on the correct translation of Participle II:

Electromagnetic waves with frequencies in the terahertz range (300 GHz to 10 THz) have applications in many areas, from imaging and security screening to the atmospheric and biological sciences. Semiconductor devices called quantum

cascade lasers (QCLs) provide the most compact and efficient way to generate terahertz radiation. In QCLs, electrons cascade down in energy through a series of discrete quantum energy levels, emitting a photon at each step. But, as with all compact semiconducting lasers, QCLs are notoriously sensitive to fabrication imperfections, which results in device-to-device variability of the laser output frequency. Now, writing in *Nature*, Zeng *et al.* report the realization of a terahertz QCL that is insensitive to such disorder. This achievement opens the door for terahertz lasers and optoelectronics that have unprecedented stability and fabrication reproducibility.

Lasers use a process known as optical feedback to build up light intensity and stimulate electrons to emit photons. A common way to introduce this feedback uses a structure called an optical cavity, which is typically composed of mirrors that reflect the emitted light back into the device. Compact lasers, however, use more-complex structures such as photonic crystals – materials that have a periodically varying refractive index. If this periodicity is carefully engineered, photonic crystals can be used to reflect light waves of only the desired frequency, and so achieve lasing. But this approach is highly sensitive to disorder, because any imperfections in the photonic crystal cause reflections that result in waves of unwanted frequencies. These compete with the desired waves, leading to unstable light intensity and poor laser efficiency.

UNIT 23

TRANSLATION OF ADVERBIAL MODIFIERS: GERUND

Translate the text into Ukrainian focusing on the correct translation of *gerund:*

The approach has many advantages over existing 3D-display techniques. Hologram technology creates 3D images by sending light through a 2D screen that contains a diffraction grating. The grating manipulates the light rays' paths such that they interfere to create the perception that an image has depth. State-of-the art holograms can be full colour and life-sized but, because the light must always emerge from a 2D surface, the viewing angle is limited. And because changing a diffraction grating at speed is challenging, holograms are also generally static.

Volumetric displays – as their name suggests – physically recreate an image in 3D space. Instead of projecting images onto a rapidly spinning 2D screen like most modern screens do, more sophisticated displays – including some made by researchers at the Keio University in Tokyo that inspired Smalley – use balls of super-heated plasma in 3D space. But these can currently use only a single colour. Other approaches use augmented-reality hardware, such as Microsoft's HoloLens, that can create the illusion of a real-world 3D image. But besides being very advanced, these approaches need specialized headgear and are data intensive, says Smalley.

UNIT 24

TRANSLATION OF ADVERBIAL MODIFIERS: ABSOLUTE CONSTRUCTION WITH PARTICIPLE I AND PARTICIPLE II

Translate the text into Ukrainian focusing on the correct translation of absolute construction with Participle I and Participle II:

Mueller polarimetry is used in this work to study to which level of intensity and spatial distribution of electric fields the studied samples are exposed to by a non-thermal plasma jet, by measuring the Mueller matrix of an electro-optic target. Electric fields measured with electro-optic crystals are due to surface charges deposited during the interaction, following the Pockels effect. Recently it was found that simultaneously with the electric field also information is obtained involving the temperature induced by the plasma by following the photo-elastic effect. BSO ($Bi_{12}SiO_{20}$) is the electro-optic crystal used in this work with a dielectric constant of 56. This means that the studied plasma target interaction is characterized by this relatively high dielectric constant. Recent numerical work has shown that the experienced electric field inside targets of 0.5 mm thickness at floating potential are similar when the dielectric constant is higher than 4. This means that the reported electric field values and patterns in this work could be comparable to the electric field which is experienced inside e.g. a thin liquid layer, biological tissues, and polymers that are 0.5 mm when they are treated by a helium plasma jet and they are not grounded. Although, it is noted that cell models and biological tissues are more complex and hetrogeneous with a relative permittivity varying over a large range. The course of the measurements done, the BSO material has not shown signs of damage under the plasma exposure.

In the method section the calibration procedure is explained to show how the temperature spatial profile is obtained together with the induced electric field profile. This being so, the approach offers a unique diagnostic to investigate the plasma surface interaction. It has a significant advantage over conventional diagnostics where normally quantities are obtained inside the plasma in the gas phase and as such have to be extrapolated to estimate what the targeted materials experience at that instance. In our previous works, a comparison is made with a two dimensional fluid model.

REVISION

Translate the text in the area of environment protection from English into Ukrainian:

National security experts urged the elimination of all greenhouse gas emissions in a report yesterday that warns of international catastrophe if the global temperatures continue to rise on their current trajectory.

The report by the Center for Climate and Security, an independent think tank, describes familiar scenarios of escalating conflict as climate change diminishes food and water supplies, displacing millions of people.

But the report, written by a team of experts and former U.S. diplomats and military leaders, takes the bold step of saying that mitigating the risks of climate change "requires quickly reducing and phasing out global greenhouse gas emissions."

"We call for the world to achieve net-zero global emissions as soon as possible in a manner that is ambitious, safe, equitable and well-governed in order to avoid severe and catastrophic security futures," the report states without recommending pathways to its goal.

Emissions reductions that nations pledged in the Paris climate agreement of 2015 "are not nearly commensurate to contain the threat," the report says, noting that global temperatures would rise roughly 2.5 degrees Celsius above preindustrial levels by 2100.

The report also urges "climate-proofing" the world's infrastructure and institutions to build resilience to climate change that is currently underway.

"We need to start taking these threats much more seriously than we are," Kate Guy, a lead report author, said in a briefing yesterday. "Even at low, near-term levels of warming, the threats and the impacts are very, very severe. No region of the world is unimpacted, even at low levels of warming."

The report describes the likely effects of two climate scenarios. The first involves global average temperatures rising by 1 to 2 C above preindustrial levels by 2050. The second scenario involves global average temperatures rising 2 to 4 C by 2100.

Translate the text in the area of biotechnologies from English into Ukrainian:

Antibodies are critical for biological and medical research. Yet, since early 2015, the state of the antibody industry has been described as being in a reproducibility crisis. One of the main issues is the improper characterization of primary antibodies. The health research industry is saturated with discrepant validation data on the sensitivity, specificity and reactivity of a variety of antibodies against the same immunizing agents (antigens). Aside from testing with a small number of assays, such as DNA sequencing, many vendors and manufacturers do

not have a clear-cut quality assurance process for validating their antibody-based products such as commercial assay antibodies and/or therapeutics.

This inconsistency in data validation can cost researchers time and money, and in some extreme cases, their projects. In a *Nature* article in 2015, Andrew Bradbury and Andreas Plückthun estimated that in the United States alone, $800 million is spent on antibodies, and half of this sum accounts for improperly validated antibodies that lead to lengthy troubleshooting and delays for important research. One of the most prominent examples to date is that of a research group which hoped to develop a diagnostic assay against a novel ovarian cancer prognostic marker, *CUZD1*.

They ordered a kit that contained the antibody against their marker to validate their assay and spent two years of research work, thousands of patient samples and $500,000 on additional experiments only to realize that the kit's anti-*CUZD1* was actually anti-*CA125*, an antibody targeting another ovarian cancer prognostic marker, which was a product already in the diagnostic market. This situation could have been prevented if researchers safeguarded their work by testing against the right antigen prior to conducting experiments, by asking vendors how they routinely verify for the correct identity of their antibody products and/or by utilizing recombinant antibodies.

Translate the text in the area of electronics from English into Ukrainian:

The fiber-optic cables that connect the global Internet could potentially be used as seismic sensors.

In addition to giant crustaceans and creepy anglerfish, the deep oceans hide a vital piece of technology: the cables connecting almost every continent and archipelago to the Internet. But it seems those undersea cables can be used for *more* than just sending cat memes around the world.

"We can do a good job picking up earthquakes in offshore cables."

Jonathan Ajo-Franklin is an applied geophysicist at Rice University and Lawrence Berkeley National Lab. He says that fiber-optic cables are like threads of glass–and there are *impurities* built in. So when you shoot lasers through the fibers, those impurities backscatter some of the light right back to the laser source.

"We make measurements of the change in the backscattered light over time, which gives you information on the stretch of the cable at each location".

His team took advantage of a brief maintenance period when a particular cable, off the coast of Monterey, California, was not being used for communication. The researchers studied the slight deformations in the cable and were able to sense a small earthquake, pinpoint unmapped faults in the seafloor and observe movements in the water column – all of which might be of interest to oceanographers.

Translate the text in the area of aerospace technology from English into Ukrainian:

Beresheet, a modest Israeli spacecraft with the audacious aim of making a soft landing on the moon, came close but ultimately failed in its goal on Thursday. The probe crashed on the lunar surface after engine and communication troubles arose shortly before its planned touchdown. The vehicle, engineered by an Israeli nonprofit organization called SpaceIL, would have been the first private spacecraft to make a lunar landing–and would have made Israel only the fourth country to do so, after the U.S., the former Soviet Union and China.

"Well, we didn't make it, but we definitely tried," said SpaceIL president Morris Kahn during a live broadcast of the landing attempt. "I think the achievement of getting to where we got is really tremendous. I think we can be proud."

The $100 million Beresheet spacecraft was not an Israeli government project but was instead funded, built and operated through SpaceIL's efforts. It was the first of several privately funded lunar landing attempts slated for the next few years–part of a potential new international "moon rush," as both global powers and private companies race back to Earth's nearest neighbor.

Although it launched in February, hitching a ride on a SpaceX Falcon 9 rocket carrying an Indonesian communications satellite and a U.S. Air Force payload, Beresheet's journey properly began one fateful night in 2010. That was when three young Israelis–Winetraub, Yariv Bash and Kfir Damari–first pondered a private moon mission over beers in a bar outside Tel Aviv. The trio went on to found SpaceIL as way to compete for the Google Lunar XPRIZE, a contest that began in 2007. The contest had promised a first-prize purse of $20 million for the first private robotic lander to reach the moon and then complete a series of objectives, such as traversing 500 meters and sending back high-definition imagery. The three optimists decided they had a shot at winning.

Translate the text in the area of energy efficiency from English into Ukrainian:

Hydrogen is flowing in pipes under the streets in Cappelle-la-Grande, helping to energize 100 homes in this northern France village. On a short side road adjacent to the town center, a new electrolyzer machine inside a small metal shed zaps water with electricity from wind and solar farms to create "renewable" hydrogen that is fed into the natural gas stream already flowing in the pipes. By displacing some of that fossil fuel, the hydrogen trims carbon emissions from the community's furnaces, hot-water heaters and stove tops by up to 7 percent.

Cappelle-la-Grande's system is a living laboratory created by Paris-based energy firm Engie. The company foresees a big scale-up of hydrogen energy as the cost of electrolyzers, as well as of renewable electricity, continues to fall. If Engie is right, blending hydrogen into local gas grids could accelerate a transition from fossil to clean energy.

The company is not alone. Renewable hydrogen is central to the European Commission's vision for achieving net-zero carbon emissions by 2050. It is also a growing focus for the continent's industrial giants. As of next year, all new turbines for power plants made in the European Union are supposed to ship ready to burn a hydrogen–natural gas blend, and the E.U.'s manufacturers claim the turbines will be certified for 100 percent hydrogen by 2030. European steelmakers, meanwhile, are experimenting with renewable hydrogen as a substitute fuel for coal in their furnaces.

If powering economies with renewable hydrogen sounds familiar, it is. Nearly a century ago celebrated British geneticist and mathematician J.B.S. Haldane predicted a post-fossil-fuel era driven by "great power stations" pumping out hydrogen. The vision became a fascination at the dawn of this century. In 2002 futurist Jeremy Rifkin's book *The Hydrogen Economy* prophesied that the gas would catalyze a new industrial revolution. Solar and wind energy would split a limitless resource–water–to create hydrogen for electricity, heating and industrial power, with benign oxygen as the by-product.

Translate the text in the area of automotive engineering technologies from English into Ukrainian:

Delivering diapers and groceries at 25 miles per hour. The debut of self-driving cars in Miami has been rather more prosaic than the futuristic and speedy science fiction dream.

The fleet of several dozen delivery cars is an experimental collaboration between Ford, Walmart and Miami, and part of a broader effort to mold autonomous vehicles (AV) to fit the needs of Miami shoppers and businesses and Ford itself, which has committed to investing $4 billion to launch an AV fleet by 2023. The car manufacturer hopes to eventually offer far-reaching autonomous transportation services as its main line of business.

The Miami project, which has been running since November 2018, illustrates the technology's potential and the big hurdles it has yet to overcome.

Sherif Marakby, president and CEO of Ford Autonomous Vehicles (FAV), contends that the cars themselves are not the most important factor in whether autonomous vehicles are successful. More significant is how the cities prepare for their arrival. Cities have an opportunity to use AVs to help solve traffic congestion, wealth inequality and other problems, but only if they put the right systems in place. If they don't, those problems could get worse.

"It takes a lot of work with a city and its people to build a successful autonomous-vehicle operation," says Marakby. "We worked with officials in Miami for months before we even started our experiments there."

Consider the information an AV's control system needs to make its way safely and efficiently through city streets. At a minimum, the car needs to stay on the road and avoid hitting pedestrians, cars, dogs or anything else that crosses its path. It has

to interpret traffic signals, ambiguous signage, erratic human drivers, construction hoardings and hand-signals from police or roadwork crews. It must also navigate through blind intersections and around double-parked cars.

For an autonomous car to recognize such myriad potential hazards, its computer and AI software must process and interpret a flood of raw data from an array of onboard video cameras and laser-based distance-ranging equipment. And the vehicle has to do it all in real time, with a second or two to make the right decision. To ensure safety, this means that, for now, driverless cars have to go slowly – very slowly.

Translate the text in the area of neuroscience from English into Ukrainian:

Microglia were once seen solely as the brain's watchdogs–activated exclusively to guzzle pathogens and dead and dying neurons. That view has changed in recent years, as scientists have amassed evidence that these cells have wide-ranging duties: During development, they seem to help sculpt the brain by trimming away excess synapses–the connections between neurons. And microglia appear to be major players in several neurodevelopmental and neurodegenerative diseases, including autism and Alzheimer's. Yan Gu, a neuroscientist at the Zhejiang University School of Medicine in China, says he and his colleagues were intrigued by the potential link between the work on microglial pruning during early development and prior research indicating that synapses are important for the storage and coding of memories. "We wondered whether microglia can eliminate synapses in the adult brain," he says. "And what is the relationship between loss of synapses by microglia and forgetting?"

To address this question, Gu's group teamed up with other researchers at Zhejiang University in a study, including neuroscientist Lang Wang. They depleted microglia from the brains of mice with drugs administered either through food or injected directly into the brain. To assess memory retention, they used contextual fear conditioning, a technique that involves placing rodents in a cage and giving them mild electric shocks. (When the animals reenter the cage, even in the absence of a shock, the memory of the experience immobilizes them.) The researchers found that although this freezing response diminished after a few weeks in healthy animals, it remained largely intact in their microglia-depleted counterparts.

The team then conducted a series of experiments to pinpoint how, exactly, microglia mediate forgetting. They homed in on the hippocampus, a brain region involved in memory and learning, and tagged neurons that were active during the contextual fear conditioning task when the animals were making memories. (These memory-associated neurons are thought to fire together when a memory is recalled.) The researchers demonstrated that the reactivation of these cells occurred more frequently in microglia-depleted animals than in healthy ones.

Further tests revealed that forgetting was dependent on the microglia's ability to gobble up synapses–and on the activity of neurons. Suppressing the activation of

memory-associated neurons led to more forgetting in the mice, suggesting that microglia-mediated elimination was a mechanism through which less useful memories are lost. The findings were published today in *Science.*

Translate the text in the area of computer modeling from English into Ukrainian:

Public health efforts depend heavily on predicting how diseases such as that caused by the 2019 novel coronavirus, now named COVID-19 by the World Health Organization, spread across the globe. During the early days of a new outbreak, when reliable data are still scarce, researchers turn to mathematical models that can predict where people who could be infected are going and how likely they are to bring the disease with them. These computational methods use known statistical equations that calculate the probability of individuals transmitting the illness.

Modern computational power allows these models to quickly incorporate multiple inputs, such as a given disease's ability to pass from person to person and the movement patterns of potentially infected people traveling by air and land. This process sometimes involves making assumptions about unknown factors, such as an individual's exact travel pattern. By plugging in different possible versions of each input, however, researchers can update the models as new information becomes available and compare their results to observed patterns for the illness. For example, if investigators want to study how closing a particular airport could affect a disease's global spread, their computers can swiftly recalculate the risk of importing cases through other airports – all the humans need to do is update the network of flight routes and international travel patterns.

But when working with incomplete data, a small error in one factor can have an outsize effect. Uncertainty about something such as COVID-19's basic reproduction number (R_0)–the average number of new cases caused by an infected individual–can disrupt a model's results. "If you're wrong about this number, your estimate will be off by orders of magnitude," says Dirk Brockmann, a physicist at the Institute for Theoretical Biology at Humboldt University of Berlin and the Robert Koch Institute in Germany. The current estimated R_0 for the novel coronavirus varies from two to three, placing it somewhere near SARS's R_0 of two to four in 2003 but much lower than measles's R_0 of 12 to 18.

Because each unknown factor introduces more uncertainty to a model, Brockmann and some other researchers favor focusing on a more limited model that relies on just one main factor. His group has concentrated on using international flight data–without figuring in person-to-person transmission – to predict which airports represent the highest-risk gateways for the coronavirus to spread worldwide. "This risk predicts the expected sequence of countries you would find cases in," Brockmann explains. "The way it unfolded is very much in line with what the mobility model predicted."

Flight data can come from official aviation databases, making them fairly reliable, but they do not involve people's movements on the ground. For that information, researchers use different sources. Alessandro Vespignani, a physicist and director of the Laboratory for the Modeling of Biological and Socio-technical Systems at Northeastern University, leads a team that is simulating the novel coronavirus's spread using official air-travel data and predicted commuting patterns among census populations. Despite not accounting for person-to-person transmission with an R_0, such travel-focused models seem to have consistently and accurately predicted which countries face the highest risk of getting new cases of COVID-19. "If different models point in the same direction," Vespignani says, "you are more confident there is some level of realism in the results."

Translate the text in the area of maths from English into Ukrainian:

The Fibonacci sequence–0, 1, 1, 2, 3, 5, 8, 13, 21,…– is familiar to many math enthusiasts. Starting with the numbers 0 and 1, each term is the sum of the previous two terms. Fibonacci numbers and their cousin the golden ratio are a bit of a recreational math cliché. Frankly, I'm a bit tired of the Fibonacci spiral and Fibonacci numbers in pinecones. But seeing them pop up as part of the solution to Hilbert's 10th problem, I felt like I was bumping into a familiar friend in a difficult setting.

In a charming article about working with Robinson, Matiyasevich writes about the search for equations that would produce sequences of numbers with specific properties as solutions. The solutions needed to have particular recurrence relations: later solutions were combinations of earlier solutions. Robinson, Davis, and Putnam had shown that finding such an equation would be sufficient to settle Hilbert's 10th problem, and Robinson had zeroed in on finding an equation with the correct properties that would produce the powers of 2. But she couldn't quite get there.

Matiyasevich showed that the Fibonacci numbers could work instead for a modified version of Robinson, Davis, and Putnam's argument. Key to his proof was the following fact: If the square of the nth Fibonacci number divides the mth Fibonacci number, then the nth Fibonacci number divides m. (For this property to work, note that 0 is the 0th term of the Fibonacci sequence and 1 is the 1st term.) For example, the square of the 3rd Fibonacci number, 2, is 4 (so n is 3.) The number 4 divides 8, which is the 6th Fibonacci number (so m is 6). The 3rd Fibonacci number, 2, divides 6, so the property holds. The same thing works for the 4th Fibonacci number, whose square, 9, divides the 12th Fibonacci number, 144. Keeping track of m and n is a little bit challenging, but the property is not particularly difficult to verify for specific examples if you can keep them straight in your mind.

Matiyasevich writes, "It is not difficult to prove this remarkable property of Fibonacci numbers after it has been stated, but it seems that this beautiful fact was not discovered until 1969." He was able to prove it because he was familiar with

another theorem in the third edition of a number theory book by Nikolai Vorob'ev. He suspects that if the theorem had been in the earlier edition of Vorob'ev's book that Robinson had had access to, she and her colleagues may have solved the problem a decade earlier.

Matiyasevich describes not only an interesting application of the Fibonacci sequence but also a great example of how mathematics happens. Rarely if ever do lone geniuses work things out all by themselves. His ideas developed through reading other people's work. He found his way to the solution because he was asked to review a paper by Robinson: "I saw at once that Julia Robinson had a fresh and wonderful idea," he writes. It gave him ideas for a new approach to the problem, and his familiarity with Vorob'ev's helped him fill in some gaps. He was part of a community.

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