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Epilogue

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Editor's Note

It has been a tough start for ARAS to 2026; there is, alas, a long **In Memoriam** box in this first issue of the year. A bit of comic relief is provided by the surprise ending of my reprint of one of Keith Smillie's old columns, *Mousing Around*.

Despite my plea in the September issue, I still have not received an adventure story from an ARAS member for this issue. Have our lives been that dull? Remember, an *adventure* can entail a dramatic event while travelling in exotic places, but also frustration in dealing with a bureaucracy, or struggling with a computer. Gordon Rostoker's submission of a thoughtful essay in the December issue has prompted me to request similar words of wisdom from us experienced elders. Think about it. I've just heard a story from an astrophysicist about a Flat Earther who sat through her astronomy course and did well on the exams, learning the course material and getting course credit; but he told her that he still didn't believe it. The story made me wonder about the success of my courses in human evolution...

Ruth Gruhn

Notices

At this academic year's last Lunch With ..., on **March 25**, Geoff Holroyd (Canadian Wildlife Service; Co-founder and current Chair, Beaverhill Bird Observatory) will bring it all home to roost, so to speak, by drawing on his wealth of experience and knowledge about birds in Alberta and abroad. There will be more details about this talk, as well as time and place, in ARAS's weekly newsletter as the date approaches.

A reminder that the lunch (sandwich, soup, dessert squares, and coffee), catered by The Upper Crust Café, is available by 11:30 and costs \$25 per person (payable in person or, preferably, by Interac to ARAS at emirhse@ualberta.ca). Note that the price has increased this year, in response to the increased cost of catering.

Reports

Lunch With ... event on 28 January

Gordon Rostoker, Professor Emeritus in the Department of Physics, presented an intriguing science-based response to the universal and perennial human question, "is there a God"? He briefly reviewed complex adaptive systems on earth, from the collective behavior of ants to the 37 trillion cells and 40 trillion bacteria that make up the human body. He proposed that the next level up as a complex adaptive system was Gaia, a global system operating electrically and encompassing all organic and inorganic matter. In that sense Gaia could be viewed as God. The next level up would be the Universe, whose stars and galaxies look like a neural network, with so-called dark energy and dark matter unexplained. Quantum entanglement, which still exists in the Universe suggests that, at the quantum level, this amazing organization of the constituents of the Cosmos may also be thought of as God.

Ruth Gruhn

Lunch With ... event on 25 February

Alison Criscitiello, Director of the Canadian Ice Core Laboratory at the University of Alberta, gave a beautifully illustrated description of the 2022 field expedition to collect long ice cores in deep ice fields on the summit plateau of Mount Logan (Yukon), at 5959 m the highest mountain in Canada. The presentation featured spectacular photographs of the field camp, the process of drilling, and removal of the cores by helicopter (the field crew had to make their own way down). The frozen cores are now under study at the U of A laboratory.

Long, deep ice cores are invaluable in providing evidence of changes in the chemistry of the snow/ice over time, reflecting rate of snow accumulation, temperature changes, wildfires, volcanic eruptions, and human pollution –which can be dated. Dr. Criscitiello also presented a brief summary of a more recent field expedition (2024) to Axel Heiberg Island, where a 613 m long core (to bedrock) may yield a 10,000-20,000 year record of climate change in the high Arctic.

Ruth Gruhn

In Memoriam

Bob Ascah	Economics
Bob de Frece	Music
Ann Hall	Sport and Recreation
Ray LeBlanc	Anthropology
John McDonald	Physics; V.P. (Academic)
Kenneth Munro	History
James Scott	Psychiatry
Gordon Thompson	Dentistry
Bill Vanden Born	Agriculture

Also of note: Barbara Horowitz, widow of former University President Myer Horowitz.

Mousing Around

Keith Smillie

57. Prime Numbers Again and a Puzzle

About the last place I would have expected to learn something new about prime numbers is in a mystery novel. However, this happened to me recently when I was reading *The Private Patient* by P. D. James. In one incident the police were able to trace a car because they found a person who remembered the registration W341 UDG, since, as the informant said, the number 341 was a “brilliant number” and UDG could stand for “U Done Good”. He defined a brilliant number as one that could be factored into two prime factors of equal length, and

that 341 was such a number since it had the factors 11 and 31. He also said that they were used in cryptography. This definition of a brilliant number was news to the police, and also to me.

A search of the Web using Google produced thousands of references to brilliant numbers that appear to have been defined about the time that *The Private Patient* was being written. It would be interesting to know how the author came upon the term. Incidentally, the number 943 which I left with you at the end of an earlier column is a brilliant number with the factors 23 and 41. The public keys used in public key encryption are the product of two very large primes of equal length and are thus brilliant numbers. Their factoring was given as an example of a problem that was beyond the power of present-day computers.

However, examples of problems requiring a very large amount of computing do not have to be limited to those requiring any great mathematical expertise to understand. An excellent example is given by the Tower of Hanoi puzzle, which appears to have originated in late nineteenth-century France. One version manufactured by Brio, the Swedish manufacturer of wooden toys, is shown in the figure. It consists of three pegs fastened to a stand and eight wooden discs of different radii each with a hole in the centre. (Although this model has eight discs, any number of discs is allowed.) As is shown, the discs are placed on one of the pegs with the largest disc on the bottom, followed by the second largest, and then the third largest, ..., and finally the smallest disc on top. The object of the puzzle is to transfer the discs from one peg to one of the other pegs by moving one disc at a time and without ever placing a disc on top of a smaller disc.

If there is only one disc, the puzzle may be obviously solved in a single move. If there are two discs, the puzzle may be solved in three moves as follows: The top disc is moved to either of the other pegs, the bottom disc is moved to the third peg, and finally the disc which was moved first is moved again and put on the other disc. A little thought will show that with three discs the minimum number of moves is seven. It may be shown that in general with n discs the minimum number of moves is $2^n - 1$. Substituting n equal to 1, 2 and 3 will give values of 1, 3 and 7, respectively, which we just found. If $n = 0$, the formula gives the number of moves to be 0, which is reasonable, since if there are no discs there is nothing to do. In our puzzle since there are 8 discs, the number of moves is $2^8 - 1$ or 255.

The following story, retold in George Gamow's delightful *One, Two, Three ... Infinity*, gives a fictitious account of the Tower of Hanoi puzzle:



In the great temple at Benares, beneath the dome which marks the centre of the world, rests a brass plate in which are fixed three diamond needles, each a cubit high and as thick as the body of a bee. On one of these needles, at the creation, God placed sixty-four discs of pure gold, the largest disc resting on the brass plate, and the others getting smaller and smaller up to the top one. This is the tower of Bramah. Day and night unceasingly the priest transfers the discs from one diamond needle to another according to the fixed and immutable laws of Bramah, which require that the priest on duty must not move more than one disc at a time and that he must place this disc on a needle so that there is no smaller disc below it. When the sixty-four discs shall have been thus transferred from

the needle on which at the creation God placed them to one of the other needles, tower, temple, and Bramins alike will crumble into dust; and with a thunder clap the world will vanish.

The number of moves is $2^{64} - 1$, which is equal to 18,446,744,073,709,551,615. Gamow remarked that if the priests worked day and night without holidays or vacation, making one move every second, the time required to move the discs from one needle to another would be slightly more than fifty-eight thousand billion years. He goes on to say that the total age of the universe is estimated to be less than 2×10^{10} years, which is considerably smaller than the 5.8×10^{13} years required by the priests to move the discs.

The above legend reminds me of Arthur C. Clark's short story, "The Nine Billion Names of God," in which Tibetan monks are attempting to achieve the same end by finding all the names of the Supreme Being; and have acquired a computer to enumerate and list the names. At the end of the project, the two American computer maintenance engineers, who have been very skeptical all along, leave the monastery to return home. They look up, and "Overhead, without any fuss, the stars were going out".