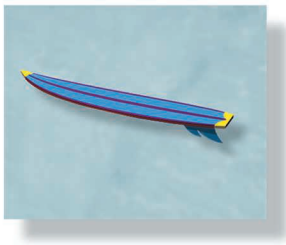

Microwave Surfing

The Annual Quiz

■ **Rajeev Bansal**

As New Zealander geophysicist Gillian Turner's book *North Pole, South Pole: The Epic Quest to Solve the Great Mystery of Earth's Magnetism* [1] shows, our planet's magnetic properties have intrigued people since ancient times. This quiz offers a quick tour of the early history of geomagnetism. It is now time to grab a pen and test your own knowledge of this fascinating subject! Google and ChatGPT are *not* allowed. The answers appear elsewhere in this issue.

1) The solar wind (energetic charged particles from the sun) and cosmic rays are safely deflected by Earth's…
   a) ozone layer
   b) magnetosphere
   c) ionosphere
   d) none of the above.
2) The sun is strongly magnetic and (in addition to Earth) so is/are the following planet(s)…
   a) Venus, Mars, and Mercury
   b) Pluto
   c) Jupiter, Saturn, Neptune, and Uranus
   d) none of the above.

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3) The earliest ideas on the nature of magnetism are attributed to the Greek philosopher…
   a) Aristotle
   b) Pythagoras
   c) Thales
   d) none of the above.
4) The earliest recorded use of the compass was in the first century AD in …
   a) India
   b) China
   c) Egypt
   d) none of the above.
5) Englishman Alexander Neckam, writing in the late 12th century, reported the use of a magnetic compass for navigation by European sailors. This was _____ Marco Polo's visit to China.
   a) before
   b) after
   c) much later than
   d) none of the above
6) The _____ Medal of the European Geosciences Union honors the 13th-century French scholar who discovered the difference between the north and south poles of a magnet and the polarity-based magnetic attraction/repulsion.
   a) Petrus Peregrinus
   b) William Gilbert
   c) Andre-Marie Ampere
   d) none of the above.
7) The inclination (the "dip" of a freely suspended magnetic needle, which depends on the latitude) was described in 1581 by the English hydrographer _____.
   a) Georg Hartmann
   b) Robert Norman
   c) Francis Bacon
   d) none of the above

Editor's Note: An earlier version of this column appeared originally in the June 2023 issue of the *IEEE Antennas and Propagation Magazine*.

8) The American Geophysical Union held a special session at its Spring 2000 meeting to celebrate the 400th anniversary of the publication of *De Magnete* (*On the Magnet*) by _____.
   a) Wilhelm Eduard Weber
   b) Carl Friedrich Gauss
   c) William Gilbert
   d) none of the above.
9) In the final chapter of Book I of the multivolume treatise *De Magnete*, the author presents his famous conclusion that the Earth _____.
   a) owes its magnetism to moving charges
   b) has a lodestone core
   c) is a great magnet
   d) none of the above.
10) The author of *De* Magnete was aware of declination (the deviation of the compass needle from the geographical north). We know now that this declination _____.
   a) is time invariant.
   b) is location independent
   c) varies with both time and place
   d) none of the above.

References

[1] G. Turner, *North Pole, South Pole: The Epic Quest to Solve the Great Mystery of Earth's Magnetism*. New York, NY, USA: The Experiment, 2011.

[2] R. Bansal, *From ER to E.T.: How Electromagnetic Technologies Are Changing Our Lives*. New York, NY, USA: Wiley-IEEE Press, 2017.

Answers to the Annual Quiz

All the answers are derived from [1] and [2].

1) b) Magnetosphere (the region around Earth dominated by our planet's magnetic field).
2) c) Jupiter, Saturn, Neptune, and Uranus.
3) c) Thales (circa 624–546 BC) was a contemporary of Pythagoras. His own writings do not survive, but his hypothesis ("magnet has a soul because it moves the iron") was reported later by Aristotle (384–322 BC).
4) b) China. (It was apparently also used in the ancient art of feng shui.)
5) a) Before. (Marco Polo did not visit China until 1275, almost a century after Neckam's descriptions of the magnetic compass for navigation.)
6) a) Petrus Peregrinus.
7) b) Robert Norman.
8) c) William Gilbert.
9) c) Is a great magnet. (The original Latin was "Magnus magnes ipse est globus terrestris.")
10) c) Varies with both time and place.

From the Guest Editor's Desk *(continued from page 10)*

In the second article [A2], we embark on a thorough exploration of the world of frequency synthesis, delving into its significance in shaping the future of wireless communication and sensing systems. The author starts by establishing a robust foundation with general definitions and requirements, followed by an exhaustive review of the main synthesizer architectures. Direct analog, direct digital, and indirect techniques are rigorously compared in terms of performance, circuit complexity, and cost impact. The design tradeoffs are critically analyzed, and the discussion is further enriched with an in-depth review of fractional-N, DDS, frequency offset, multiloop, and other schemes. The article concludes by illuminating the current state and future development trends of microwave frequency synthesizers, equipping readers with a contemporary overview of this indispensable aspect of the field.

As the era of 5G and beyond unfolds, the significance of advanced signal generation and synthesis techniques becomes increasingly crucial for the successful implementation and deployment of next-generation communication and sensing systems. This focused issue aims to offer a comprehensive outlook on the latest research and breakthroughs in these areas.

Looking ahead, our focus issue will also address the critical aspect of frequency conversion, as these two engaging articles represent merely a subset of the stimulating content we have planned for our valued readers. I sincerely hope that these articles will prove both intellectually stimulating and informative, as they delve into the intricate nuances of our field.

At this juncture, I would like to express my profound gratitude to the contributing authors for their outstanding work, as well as to all the reviewers who offered invaluable suggestions and insights. Additionally, I extend my warmest thanks to the unwavering support of the MTT-10 Technical Committee for this focused issue.

Appendix: Related Articles

[A1] J. Baylon, M. A. Hoque, and D. Heo, "Spanning the spectrum," *IEEE Microw. Mag.*, vol. 24, no. 7, pp. 16–28, Jul. 2023, doi: 10.1109/MMM.2023.3265457.

[A2] A. Chenakin, "Microwave frequency synthesizers," *IEEE Microw. Mag.*, vol. 24, no. 7, pp. 29–40, Jul. 2023, doi: 10.1109/MMM.2023.3265464.