A reminder of the powers of π

In a two-sentence Letter to the Editor of *Physical Review*, Friedrich Lenz made the noteworthy observation[1] that the value of the ratio m_p/m_e could be expressed to all significant figures of the time by $6\pi^5$. That was in 1951, and remarkably, years later the observation holds true to good approximation. His note is perhaps also the shortest article ever published in *Physical Review* (27 words, 1 number, 1 equation, and 1 reference).

Its modern version could read as follows: The most exact value at present[2] for the ratio of proton to electron mass is $m_p/m_e = 1836.152\,673\,89(17)$. Despite years of experimental improvements, that number still coincides, to good approximation, with the simple, unambiguous representation $6\pi^5$.

With the 66th birthday of Lenz's intriguing observation, it seems fitting to make his result better known to the community. This reminder should not be construed as trumpery—a showy but worthless statement—but as a comfort that some facts remain true with the passing of time.

References

1. F. Lenz, *Phys. Rev.* **82**, 554 (1951).
2. P. J. Mohr, D. B. Newell, B. N. Taylor, *Rev. Mod. Phys.* **88**, 035009 (2016).

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They may not be out there

My colleagues Mario Livio and Joe Silk, in their article "Where are they?" (PHYSICS TODAY, March 2017, page 50), have underplayed the most straightforward answer by far to the question Enrico Fermi posed. That answer is that if they exist, they are too far away to have made it here. The universe is big and getting bigger, and the speed of light places a strict constraint on travel times. Possible signals from aliens, even if intelligence were abundant throughout the cosmos, would typically take thousands or even millions of years to reach us—and their spacecraft would take even longer. The main conclusion to be drawn is that we will probably be unable to know for a very long time whether they even exist.

Yes, some aliens might be nearby. Earth is located in a spiral arm of the Milky Way about 25 000 light-years from the center of the galaxy, whose disk spans 100 000 light-years. More precisely, the Sun lies in a cavity of interstellar gas called the Local Bubble, which extends over roughly 600 light-years.[1] It in turn is located in the Gould belt, a spur of stars, star clusters, and molecular clouds between two of the galaxy's spiral arms. The belt stretches to about 1200 light-years in its longest dimension. The approximate number of stars per cubic light-year in our immediate solar neighborhood is 0.004, to within a factor of two, so it holds about 30 million stars of all types.

Our earliest broadcasts have only made it out to about 100 light-years. What are the chances of chatting with alien neighbors if we wait and listen for

the next 1200 years, long enough for the farthest signals in the neighborhood to reach us? The combined chances need to be better than about 1 in 30 million. If the stars are too big or too small, if the planets' orbit or obliquity are wrong, their sizes or chemical compositions unsuited, their surfaces ill equipped, their geologic and meteoritic history too inauspicious, then we are alone. Then add in the biological uncertainties, which are much less well understood: If the chemistry needed to generate life is too intricate or too slow, if evolution from proteins to intelligence is too often aborted or misdirected, or if civilizations die off quickly, then, too, we are alone.

I support the search for extraterrestrial intelligence. If we don't look, we won't find them. But it is a risky endeavor, and nonprofessionals should keep in mind the complex and contingent evolutionary history of intelligence on Earth and the enormous limitations imposed by the finite speed of light. Livio and Silk end their discussion by asking, "Are we alone? The answer may affect nothing less than our claim for being special in the cosmos. . . . We shall never know unless we search!" That search, however, could very likely last an astronomically long time.

I think my own community of scientists has hopped aboard an optimistic science fiction bandwagon while being insufficiently honest in highlighting the many cautions. Percival Lowell, famous for his search for Pluto and his studies of the canals of Mars, wrote in 1908, "From all we have learned of its constitution on the one hand, or of its distribution on the other, we know life to be as inevitable a phase of planetary evolution as is quartz or feldspar or nitrogenous soil. Each and all of them are only manifestations of chemical affinity."[2]

No one believes that today. Every schoolchild knows that Mars has no artificial canals and no Martians either. Lowell's confident assumption was wishful thinking, and we should beware of making similar assumptions.

A companion issue is not nearly as ambiguous: the ethical one. If the human race might be alone, with no one to talk with, then we face the possibility that neither we nor our planet are commonplace; we might even be rare. The implications are that Earth and its life have cosmic value, that we have concomitant responsibilities, and that we will have to solve our problems without advice from superintelligent beings from space. The prospect brings great urgency to the cause of protecting our rare planet and its precious inhabitants.

References

1. H. A. Smith, *Am. Sci.* **99**, 320 (2011).
2. P. Lowell, *Mars as the Abode of Life*, Macmillan (1908), p. 37.

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Calling computers names in Swedish

I very much enjoyed reading Jim Fleming's article on Carl-Gustaf Rossby and the seminal contributions Rossby made to meteorology (PHYSICS TODAY, January 2017, page 50). However, the oth-