Neural systems have two innate requirements: communication and computation. Any large-scale neuromorphic system striving for complexity at the level of the human brain and beyond will need to be optimized for both. This has led to the proposal of optoelectronic neuromorphic platforms that leverage the complementary properties of optics and electronics. Optical communication allows for direct connections between neurons, which removes bottlenecks associated with network traffic. Electronic computation allows for complex synaptic and neuronal functions. Starting from the hypothesis that future large-scale neuromorphic systems will utilize integrated photonics and fiber optics for communication in conjunction with electronics for computation, we analyze and contrast two possible paths towards achieving this vision. The first is a semiconductor platform based on analog CMOS circuits and waveguide-integrated photodiodes. The second is a superconducting approach that utilizes Josephson Junctions (JJs) and waveguide-integrated superconducting nanowire single photon detectors (SNSPDs). The study reaches several conclusions. First, it is demonstrated that these two systems are capable of implementing similar synaptic and neuronal dynamics. With this established, the two platforms are compared from a variety of different viewpoints: power consumption, speed, area, available memory technologies, cryogenic overhead, and feasibility of fabrication. While both platforms still require significant technological innovations to become viable, we reach some early conclusions about their limits and device performance metrics that will likely need to be met in order for optoelectronic neuromorphic supercomputers to become a useful paradigm. Notably, it is found that the minimum possible energy used for communicating events is likely to be of the same order in both cases, but the superconducting approach dramatically lessens the optical power required of the integrated light-sources, which remain the most speculative element of both platforms. Additionally, for either technology, realization of such large-scale systems will require wafer-scale fabrication with multiple repeated layers of passive photonic waveguides and synaptic computational circuits. This will require processing multiple layers of MOSFETs and photodiodes in the semiconductor case and multiple layers of JJs and SNSPDs in the superconductor case. An ideal neuromorphic platform also possesses truly local memory integrated within synaptic circuits. While synaptic circuits with activity-based plasticity mechanisms have been pursued for decades in CMOS hardware, learning functionality is still left wanting. By contrast, flux storage loops in superconducting circuits appear promising for synaptic adaptation based on the same signals used elsewhere in the network for communication and computation. While this study cannot determine which nascent platform will be superior in the future, it enumerates a list of technological advances that will be required if either approach is going to achieve its lofty ambitions. The hope is that with these intermediate goals identified, the community can accurately assess the progress of both platforms in future years and use that measure to determine for itself which platform will be best suited for the long march toward artificial neuromorphic general intelligence.