Neural systems have two innate requirements: communication and computation. Any large-scale neuromorphic system 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 computation. 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 and waveguide-integrated superconducting nanowire single photon detectors (SNSPDs). First, it is demonstrated that these two systems are capable of implementing ~~nearly identical~~ neuronal dynamics. With this established, the two platforms are compared from a variety of different viewpoints: power consumption, speed, area, potential for 3D integration, 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 of magnitude 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. This may ultimately result in a fabrication process that is simpler in the superconducting case than in the semiconductor platform, but at present, the semiconductor approach benefits tremendously from the maturity of its fabrication processes.